AGRICULTURAL NEWS LETTER

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This publication contains information regarding new developments of interest to agriculture based on laboratory and field investigations by the Du Pont Company. It also contains published reports of investigators at agricultural experiment stations and other institutions as related to the Company's products and other subjects of agricultural interest.

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AGRICULTURAL NEWS LETTER

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L. F. LIVINGSTON, *Manager*

R. M. ROBERTS, *Editor*

WHAT FARM EDITORS ARE SAYING --

"Without the benefits of the past 100 years of research in entomology and insect control and the application by the American public of the knowledge gained therefrom our annual per acre yields of crops and livestock probably would be half or less of those of today. In addition, thousands of people now living would be dead and hundreds of thousands would be ill from the diseases insects carry." -- Walter Murphy in JOURNAL OF AGRICULTURAL AND FOOD CHEMISTRY

"Too many people who are trying to farm today seem to feel they should be able to make money by using the same general farming practices their fathers and grandfathers used. But the day has come when knowledge and good planning is much more important than a strong back." -- J. O. Matlick in THE KENTUCKY FARMER

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"We are outgrowing everything -- billions of dollars of investment in new and larger manufacturing plants and all manner of services will be required." -- HOLSTEIN-FRIESIAN WORLD

DR. HARRY F. DIETZ, manager of the agricultural chemical research section of Du Pont's Grasselli Chemicals Department and active as both a contributor and advisory board member of AGRICULTURAL NEWS LETTER, died Saturday, September 4, of a heart attack at his home near Chadds Ford, Pennsylvania. Dr. Dietz was 63 years old and had been employed by the Du Pont Company for the past 22 years. Throughout the country, he was known and respected for his thorough knowledge of insect pests, weeds, plant diseases, and methods of pest control. He had authored a number of works on entomology; was a fellow of the Indiana Academy of Science, the Ohio Academy of Science, and the American Association for the Advancement of Science; held memberships in the Entomological Society of America, Sigma Xi scientific honor society, Gamma Sigma Delta agricultural honor society, and Phi Delta Theta fraternity. Prior to joining Du Pont, he had served in several capacities in the office of the Indiana State Entomologist, had been an assistant in entomology at the Montana Experiment Station, Bozeman, Montana, and an entomological inspector in the Federal Horticultural Board and Bureau of Entomology of the U.S. Department of Agriculture. During his association with Du Pont, Dr. Dietz played a prominent part in the development of many new agricultural chemicals.

INTERNAL PARASITES? -- SEE FOR YOURSELF!

In reading about internal parasites, particularly in cattle, you've probably noticed that even the experts consider it difficult to recognize parasitism, especially at low levels. Yet in apparently healthy animals stomach worms and other parasite infections may be doing continual damage -- suppressing growth and gains.

Parasites themselves are conspicuous enough if they can be isolated under a low-power microscope, and there's a simple procedure for doing so. This procedure is described in a new "project outline" prepared by technical personnel in the Du Pont Company. Equipment for the demonstration is familiar to any high school biology student -- low-power microscope, glass funnel, tubing, test tube, and pinch clamp. In this project, it can be demonstrated that even blue-ribbon show cattle may be infected with worms.

The outline also describes the "low-level" phenothiazine medication treatment which controls parasites and prevents re-infection.

Internal worm parasites go through a life cycle which has to be interrupted to achieve full control. Live worms in the digestive tract produce large numbers of eggs which pass out in the manure. These eggs then hatch into larvae, which crawl into the grass, or remain as dormant larvae. Then the grazing animals pick up the larvae which are swallowed, and then passed into the stomach and lower digestive tract where they become adult worms. With a preventive medication program, the infection is reduced in the animals themselves, so that gradually the build-up of parasites in the pasture is eliminated.

Surveys throughout the nation have shown that worm parasites infect cattle in all regions, and are particularly serious in warm climates. Heavy rainfall, high temperatures and concentrated stocking of grazing land are commonly associated with heavy infections.

Experience shows that a preventive medication program is best for control of internal parasites in cattle, because it begins with the young animal. Kept free of internal parasites which reduce feed efficiency and sap vigor, a young animal can make full gains and reach the best production level without wasting feed and vigor fighting parasites.

It has been estimated that a preventive medication program costs less than four cents per week per head. Field tests on apparently healthy cattle, known to be carrying only a few parasites, have shown an average return of 12 dollars in extra gain for each dollar spent on phenothiazine.

County agents, instructors in vocational agriculture, 4-H Club leaders and others interested in a "see for yourself" demonstration of parasite infection and control may obtain a copy of the project outline by writing the editor of AGRICULTURAL NEWS LETTER, Du Pont Company, Wilmington, Del.

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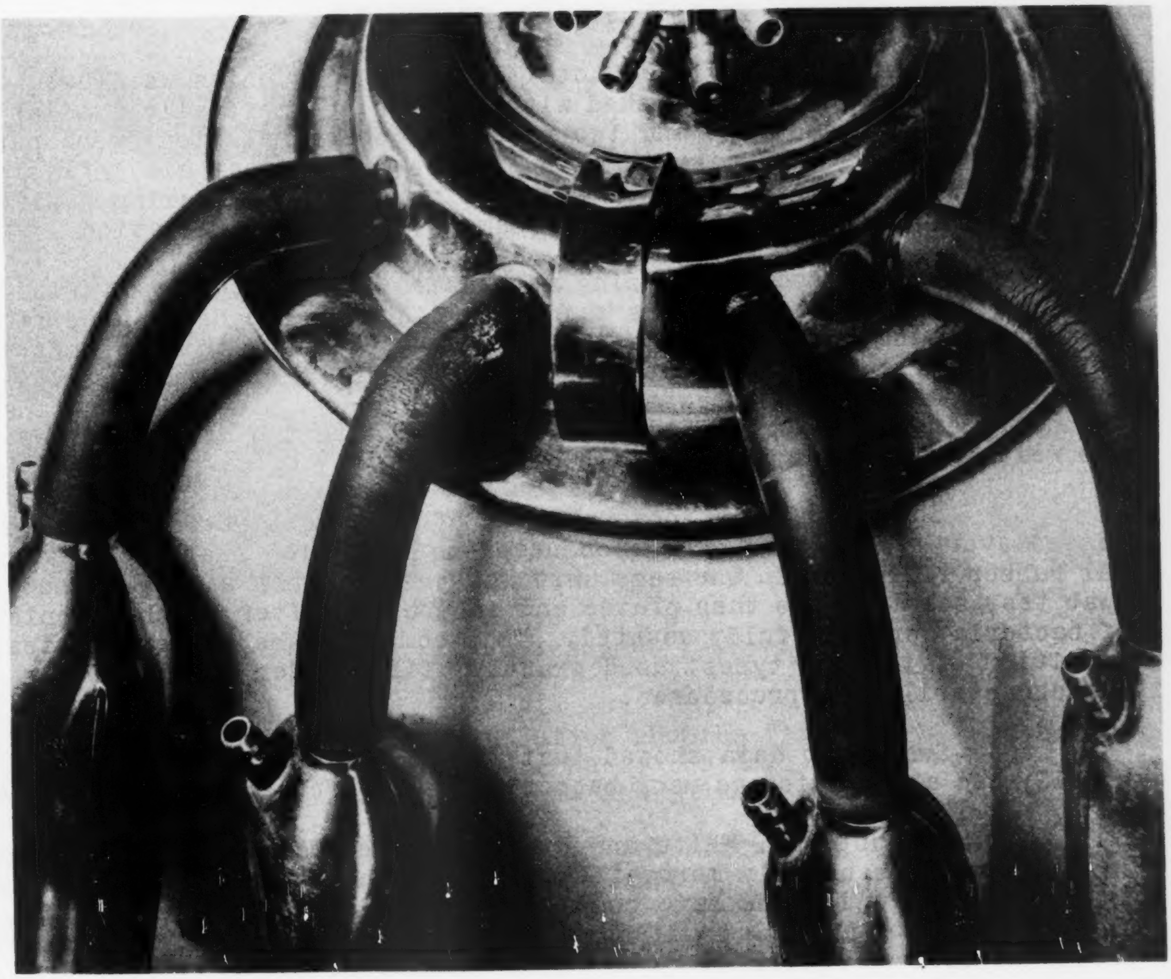


These four inflations were all placed in service on April 12. Photo was taken August 14, after 124 days of service. Note condition of neoprene tubes which are first and third (reading left to right), as compared with cracking and checking in rubber tubes in second and fourth positions.

CORNELL STUDY SHOWS NEOPRENE INFLATIONS FAR OUTLAST NATURAL RUBBER

That neoprene milking machine inflations last twice as long as natural rubber, make for improved sanitation, and milk faster, was brought out in a recently published report describing a year-long study of inflations at Cornell University.

The report, published in the August issue of "Journal of Milk and Food Technology," tells how Dr. J. C. White, Professor of Dairy Science at Cornell, and G. R. Folds, now with Eastern Dairy Products Corporation, compared neoprene and natural rubber inflations in carefully controlled tests under actual farm conditions. The researchers point out that neoprene -- because of its greater resistance

to the destructive action of butterfat, heat, and chemicals -- would be expected to last longer. Until the Cornell study, however, a critical comparison in the field had never been made.

Eight farms having a total of 25 milking units were used in the tests, and each was furnished with regular, commercially available inflations. Two neoprene and two natural rubber inflations were put on each machine. The dairymen were instructed to treat all inflations exactly as they were accustomed to treating their own, making replacements on each type at precisely the same stage of deterioration.

Washing and sterilizing methods on the eight farms varied widely. Most of the operators said they did a thorough job after the morning milking, but the research staff observed that this was not always so. While farm No. 3 did wash their equipment thoroughly twice a day, the usual evening treatment on the others was a cold water rinse. One dairyman (farm No. 7) didn't even bother with the evening rinse if the weather that night happened to be cool.

The same inflations on seven of the eight farms were swab tested every two weeks. For each neoprene inflation swabbed, a natural rubber inflation on the same unit was treated in a similar manner. Swab test solution was then plated and incubated, after which colonies of bacteria were carefully counted. This compared the bacteriological condition of the two types, used exactly alike, under identical washing and sterilizing procedures.

Swab test data showed that the natural rubber inflations usually had about twice as many bacteria as were found on the neoprene.

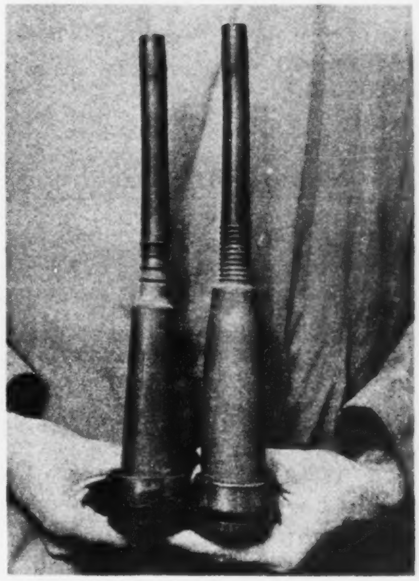
To quote Dr. White and his colleague, "The results indicate that neoprene is usually more effectively cleaned and sterilized than natural rubber under the same conditions. On farms where the best cleaning and sterilizing conditions prevailed, neoprene proved far superior to natural rubber in terms of the number of bacteria recovered."

Because bacteria might be harbored in tiny surface crevices and not be collected by swabbing, the Cornell group decided to set up a test which would show the degree of retention. A small, portable unit was devised for use on the farms. It consisted of a vacuum pump, a stall cock, sanitary trap, and vacuum controller. A pulsator and claw were connected to the stall cock. By attaching the air tube from the shell to the claw, the pulsating action of a milking machine was realistically duplicated. Sterile rubber stoppers were placed in the teat openings of the inflations, and the inflations were filled with sterile water. After pulsating the inflations for five minutes, the water was plated, incubated, and counted.

To see whether this test method would give different or more reliable figures, two neoprene and two natural rubber inflations were tested by this technique on farm No. 7, while four of each type were pulsated on farm No. 5. Again quoting from the report, the pulsating test "shows neoprene inflations were bacteriologically superior to

In six months, this New York dairyman (at left) cooperating in the Cornell tests replaced 12 rubber inflations due to swelling and distortion, which rendered them unfit for service. Only two neoprene inflations were replaced during this period -- both accidentally damaged.

The two inflations shown at right were both in service on the same farm, under identical conditions for 231 days. Weighing and measuring methods employed in the Cornell test showed the neoprene inflation on the left to be virtually unchanged, while the swelling due to fat absorption and general distortion of the rubber inflation on the right is quite evident.



natural rubber," further confirming that neoprene is less likely to build up high "bug counts."

A milking machine inflation absorbs fat and, in so doing, becomes distorted. Added fat increases the inflation's weight, while distortion changes its volume and milking efficiency.

To determine the amount of fat absorption, each of the test inflations was weighed before it was placed in use, then weighed again when it was removed from service for any reason. Distortion was determined by measuring each inflation's volume, to the nearest half milliliter, before use and again after removal. Weight and volume increases are shown in Table I.

TABLE I

	Average period of use (days)	Number of Inflations	Volume Increase* (milliliters)	Weight Increase* (grams)
Rubber	128	79	14.4	8.0
Neoprene	214	60	1.5	2.1

*Calculated per 100 days use.

Volume increase of the rubber inflations averaged almost 10 times that of neoprene inflations, while weight increase for rubber was about four times that of neoprene. The Cornell staff observed that increases in weight and volume were much more pronounced in the later stages of use; since many of the rubber inflations were no longer serviceable in less than 100 days, they actually performed more poorly than this table shows. A number of rubber inflations

which were used for 170 days showed volume increase of more than 35 milliliters and weight increases upwards of 15 grams.

Dr. White points out that more rubber inflations were studied because their shorter life required more replacements, as seen in Table II.

TABLE II

Reason for Removal	Rubber	Neoprene
Worn out	33	0
Accident	4	9
Replaced by other types*	16	10
Tubes enlarged and set	0	3
Total	53	22

*These inflations were still functioning well.

"Many of the rubber inflations failed in only three months," Dr. White relates, "and all but a few were completely unserviceable in six months' time." On the other hand, the report shows that not one of the neoprene inflations had actually worn out over the entire one-year period, and that the three which had lost elasticity in the narrow tube did so only after extended use.

Milking efficiency in terms of time required to milk, and amount of milk obtained, was also studied. Two farms were set up for this test. On one farm five cows were selected at random from the herd. The other farm had only eight cows in lactation at the start of the test -- another freshened a week later and was also included. On each farm, one machine was equipped with neoprene inflations, and another was equipped entirely with natural rubber.

In Trial 1, the five cows were first milked for three weeks with the neoprene-equipped machine, then for three weeks with the natural rubber inflations. Milking time required and amount of milk obtained were recorded three days each week during both periods.

The vacuum line became partially plugged on the seventh day the neoprene-equipped machine was used, resulting in an abnormally long milking time for cows No. 1 and No. 4. Despite this handicap, the neoprene inflations milked faster on all five cows, ranging from 13 seconds faster on cow No. 1 to one minute and 29 seconds faster on cow No. 5 (see Table III).

On the other farm, cows Nos. 1, 2, 4, 5, and 8 were milked with neoprene inflations the first three weeks, then with the rubber-equipped machine for a similar period. Cows Nos. 3, 6, 7, and 9 were milked with the natural rubber inflations for the first three weeks, followed by a three-week period with the neoprene-equipped machine.

The neoprene-equipped machine proved faster on five of the nine cows tested (in one case, two minutes and 19 seconds faster) and the same on one cow; rubber won out on only three.

TABLE III

Average Time of Milking and

Average Weight of Milk Produced

Trial 1

Cow	Rubber Time Min.	Rubber Time Sec.	Rubber Weight Pounds	Neoprene Time Min.	Neoprene Time Sec.	Neoprene Weight Pounds
1	6	30	24.05	6	17	24.05
2	4	05	15.50	3	44	16.75
3	6	20	29.40	5	24	29.60
4	6	31	23.50	5	39	24.90
5	6	55	23.60	5	26	23.70
Average:	6	04	23.20	5	19	23.85

Trial 2

Cow	Rubber Time Min.	Rubber Time Sec.	Rubber Weight Pounds	Neoprene Time Min.	Neoprene Time Sec.	Neoprene Weight Pounds
1	8	14	27.90	5	55	27.65
2	5	23	21.90	4	12	22.50
3	6	02	10.20	6	28	9.70
4	6	11	12.90	5	39	13.60
5	7	50	15.90	7	40	16.50
6	6	23	9.45	6	21	8.95
7	3	46	16.15	3	46	15.20
8	6	24	13.20	6	32	13.25
9	4	05	19.95	4	48	21.50
Average:	6	10	16.15	5	42	16.45

Conclusions stated in the report are as follows:

"1. Under the same conditions of cleaning and sterilizing the bacterial counts of neoprene inflations were lower than those of natural rubber inflations.

"2. Neoprene inflations develop less distortion than rubber inflations in field use, because of greater resistance to fat absorption.

"3. Neoprene inflations have approximately two times the service life of natural rubber inflations.

"4. Neoprene inflations were more efficient in the milking operation than natural rubber inflations in a limited series of tests."

#######

UREA USED TO INCREASE PROTEIN CONTENT

OF HIGH GRAIN DROUGHT FEED FORMULAS

Prolonged drought conditions have caused an acute shortage of home-grown grains and a general decline in pasture quality and yield in many areas of the United States. As a result, these areas suffer both a shortage of energy-producing feeds and of protein for livestock feeding.

A federal Emergency Feed Program, supporting high grain mixtures, has been established in drought areas to prevent serious losses in livestock production. The Feed Program regulations designate two classes of grain mixtures: Type A, containing at least 75 per cent grains; and Type B, 60 per cent grains.

A highly concentrated and effective source of protein, such as urea, is desirable in balancing ruminant feed mixtures containing a high proportion of grains. Urea has been proven nutritionally and economically sound by years of research and by actual performance in millions of tons of feed for cattle and sheep.

In a current technical bulletin, the Du Pont Company is supplying feed manufacturers with several high grain ruminant feed formulas based on research in various agricultural colleges. Each of these suggested formulas utilizes the high equivalent protein value of urea. This provides the maximum flexibility that is necessary in supplying adequate protein, mineral, and vitamin sources in such high grain feeds.

The following high grain ruminant feed formulas are designed to meet the requirements of the current drought relief program while providing nutritional balance for dairy cows, beef breeding herds, and growing cattle.

Type A -- 75 Per Cent Grains

12 Per Cent Protein

1200	lbs.	ground corn
300	lbs.	ground oats
200	lbs.	molasses
150	lbs.	dehydrated alfalfa meal
65	lbs.	oilseed meal
23	lbs.	urea
20	lbs.	bone meal
20	lbs.	limestone
20	lbs.	salt
1	lb.	trace mineral premix
1	lb.	dry Vit. A (2 M. USP/lb.)
2000	lbs.	

16 Per Cent Protein

1000	lbs.	ground milo
500	lbs.	ground oats
200	lbs.	molasses
100	lbs.	dehydrated alfalfa meal
100	lbs.	oilseed meal
38	lbs.	urea
20	lbs.	dicalcium phosphate
20	lbs.	limestone
20	lbs.	salt
1	lb.	trace mineral premix
1	lb.	dry Vit. A (2 M. USP/lb.)
2000	lbs.	

20 Per Cent Protein

1000 lbs.	ground milo	20 lbs.	salt
500 lbs.	ground oats or barley	15 lbs.	bone meal
195 lbs.	oilseed meal	15 lbs.	limestone
100 lbs.	molasses	1 lb.	trace minerals
100 lbs.	alfalfa meal	1 lb.	dry Vit. A (2 M. USP/lb.)
53 lbs.	urea	2000 lbs.	

Somewhat different proportions of oats, corn, barley, or sorghum grains can be substituted in the above formulas so long as they total a minimum of 1500 pounds per ton in compliance with the 75 per cent drought relief grain mixture regulation. The protein content of such mixtures changes somewhat with different grain substitutions. Also adjustments upward or downward in the protein percentage of the mixtures can be made by increasing or decreasing the amounts of urea of other high-protein ingredients. Where medium to high-protein roughages are available, 12 per cent protein grain mixtures are adequate in meeting the protein needs of cattle. Higher protein grain mixtures such as the 16 per cent mixture should be fed where the roughages available are poor quality and low in protein. Mixtures containing 20 per cent protein are commonly used in range feeding, particularly in the form of cattle cubes.

Type B -- 60 Per Cent Grains

Type B grain mixtures need contain only 60 per cent grain in compliance with the drought emergency mixed feed regulations. Examples of 60 per cent grain mixtures with urea are as follows:

12 Per Cent Protein

800 lbs.	ground corn
400 lbs.	ground oats
280 lbs.	ground corncobs
280 lbs.	molasses
100 lbs.	dehydrated alfalfa meal
50 lbs.	oilseed meal
28 lbs.	urea
20 lbs.	bone meal
20 lbs.	limestone
20 lbs.	salt
1 lb.	trace mineral premix
1 lb.	dry Vit. A (2 M. USP/lb.)
2000 lbs.	

16 Per Cent Protein

600 lbs.	ground milo
600 lbs.	ground oats
250 lbs.	ground corncobs
235 lbs.	molasses
100 lbs.	dehydrated alfalfa meal
115 lbs.	oilseed meal
40 lbs.	urea
20 lbs.	dicalcium phosphate
20 lbs.	limestone
18 lbs.	salt
1 lb.	trace mineral premix
1 lb.	dry Vit. A (2 M. USP/lb.)
2000 lbs.	

26 Per Cent Protein Concentrate

800 lbs.	ground milo	20 lbs.	salt
400 lbs.	ground barley or oats	15 lbs.	limestone
480 lbs.	oilseed meal	15 lbs.	dicalcium phosphate
100 lbs.	alfalfa meal	1 lb.	trace mineral premix
100 lbs.	molasses	1 lb.	dry Vit. A (2 M. USP/lb.)
68 lbs.	urea	2000 lbs.	

Wheat mill feeds or other bulky feeds of desirable molasses carrying properties can be substituted for ground corncobs in 60 per cent grain mixtures depending upon availability and ingredient costs. High protein mixtures such as the 26 per cent concentrate shown are commonly used as supplements in dairy or beef rations, to be fed along with good hay, silage, or other home grown feeds low in protein.

Complete Ration

In drought areas where corncobs are available they may be used in larger amounts and substituted for scarce or high-priced hays and fed with the above 16 per cent protein mixtures. For example, a complete feed for carrying beef breeding cows and non-lactating dairy animals through the winter without the use of hay and still meeting the nutrient requirements might be the following:

Wintering Ration for Beef Herd

Ground corncobs	1400
Type B -- 60 per cent grain mixture (16 per cent protein)	500
Dehydrated alfalfa pellets	100
	2000 lbs.

The above ration will also give good results for carrying young cattle through the winter to go on pasture in the spring. For dairy cows in milk the grain mixture and alfalfa pellets should be increased depending upon milk production. This type of complete ration without hay is free flowing and can be handled in bulk with augers and elevators either into the feed bunk or self-feeder.

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Editor's Note: Du Pont's "Two-Sixty-Two" feed compound has been formulated to supply urea for feed manufacturers in a non-caking, easily handled form.

METHIONINE PRICE REDUCED

A reduction in the price of methionine, an essential amino acid which is adding more weight per pound of feed consumed in raising broilers and turkeys, has been announced by the Du Pont Company. The lower price anticipates more economical production of this feed supplement in the company's new plant now getting under way at Beaumont, Texas. The reduction is from $3 to $2.65 per pound. It is estimated that 200 million broilers were raised on methionine-fortified mashes last year. Recent tests with more than 9,000 chicks over a 73-day period showed that use of methionine resulted in an additional 70 pounds of meat per thousand birds, coupled with 21 pounds less feed consumption per thousand birds. In addition, the supplement improves feathering and produces a better grade of dressed bird.

MORE FRUIT -- BETTER QUALITY

Report on a Ten-Year Project on Effects of Fungicides on Apple Production

Substituting an organic fungicide for one of the old inorganic materials in cover sprays for apple orchards in the Hudson Valley has resulted in a gain of 153 additional boxes of No. 1 apples per acre. While fungicide to achieve this result costs an extra penny a box, the average total cost per box was greatly reduced, since other items such as fertilizer were unchanged.

This pay-off for the grower is shown in a 10-year study of apple fungicides and their effect, reported recently by Dr. D. H. Palmiter, Professor of Plant Pathology at the Hudson Valley Fruit Experiment Station, Poughkeepsie, New York.

The organic material that made this great difference in quality apple yield was "Fermate" fungicide, first of the modern family of dithiocarbamate fungicides developed through Du Pont Company research in agricultural chemicals.

The 10-year program, started in 1943, was conducted in the W. A. McKiernan orchard near Red Hook, New York, to determine the effects of soil and foliage nitrogen applications on apple scab control. It also included comparisons between wettable sulfur and "Fermate" fungicide as sprays on McIntosh trees.

Running concurrently during five of these 10 years was a second program in the Fred DuBois orchard at New Paltz, New York, covering the effects of eight different fungicidal treatments on yield and quality of McIntosh apples.

Over the 10-year period, Dr. Palmiter noted that trees sprayed each year with "Fermate" greatly outyielded those sprayed with sulfur, when no nitrogen was used in either case. Trees sprayed with "Fermate" without the addition of nitrogen fertilizer more than equalled the yield of trees sprayed with sulfur and given nitrogen. Fruit from these trees treated with "Fermate" fungicide were also larger and showed better color than from the sulfur-sprayed trees where nitrogen was used.

In the five-year fungicide test at New Paltz, all eight materials tested had previously been evaluated for scab control and the poorest of them averaged only 3.1 per cent fruit scab. This meant that the primary concern in the experiment was the result in terms of production and fruit quality, with scab control of only secondary importance.

Highest yield recorded was 528 boxes of picked fruit per acre and this mark was made by two treatments -- an all-season application

Effect of fungicides on yield and quality of McIntosh in the Fred DuBois Orchard, New Paltz, New York, 1949 to 1953

Fungicide	Annual yield per acre in boxes		Loss of No. 1 grade due to			Quality factors		Cost per box	
	Total	No. 1	Fruit Scab %	Spray injury, %	Poor color, %	Fruit size, apples/box	Fancy color, %*	Total crop	No. 1 crop
"Fermate" fungicide	528	501	1	1	3	129	76	$ .08	$ .08
Flotation/"Fermate"**	528	491	2	1	4	126	72	.06	.06
Micronized, plus lime	516	454	2	2	8	136	60	.06	.06
Tag/"Fermate"**	480	451	1	1	4	125	70	.11	.12
Phygon/"Fermate"**	450	423	1	2	3	130	70	.08	.09
Crag 341, plus lime	468	402	2	2	10	138	60	.08	.09
Micronized	462	383	3	4	10	141	55	.06	.07
Flotation	384	338	2	3	7	140	61	.05	.05

*All treatments were picked at the same time in 1949, but in the following years the sulfur and Crag plots were picked about a week earlier than the rest in an effort to have all apples picked at the same stage of maturity. In 1953 the plots sprayed with the combination of "Fermate" and Phygon were picked with the first group.

**"Fermate" replaced the other fungicide in the cover applications.

of "Fermate" and a mixed schedule of flotation sulfur early, followed by "Fermate" in the cover sprays.

Since apples are valued on quality, the output of U.S. No. 1 grade apples is of more importance than the total yield, Dr. Palmiter points out. During the five-year period, the highest yield of these top quality apples was 501 boxes per acre from trees sprayed with "Fermate" all season.

"Fruit size and color were two of the quality factors that were measured in this experiment," wrote Dr. Palmiter in a recent issue of "Farm Research," publication of the New York State Agricultural Experiment Station at Geneva. "In general, fruit size was best in the plots where 'Fermate' was used in the cover applications. Fruit from these treatments ranged in size from 125 to 130 apples per box, whereas fruit from plots sprayed with sulfur all season ranged from 136 to 141 apples per box. Because of the dry summer in 1953, much of the sulfur-sprayed fruit was too small for a 2½-inch pack. Good size and good color seemed to go together in this experiment as the best fruit color was also developed where 'Fermate' was used in the cover applications."

When he got down to costs per acre for fungicides, Dr. Palmiter showed a range of from $17.25 for flotation sulfur to a high of $53.50 where Tag fungicide was used in early sprays, replaced by "Fermate" fungicide in cover applications. But when these figures were put on the basis of cost per box of No. 1 fruit, the difference between the lowest and highest cost was only seven cents.

This cost study showed that substitution of "Fermate" for flotation sulfur in the cover applications increased the cost per box little more than a cent, and resulted in an average gain of 153 additional boxes of No. 1 apples each year.

In addition to advantages shown in disease control and yield, Dr. Palmiter concluded that of all the fungicides tested in the Hudson Valley between 1940 and 1950 "Fermate" appeared to be the safest for all-season use on McIntosh.

"This has been indicated," he said, "by appearance of the trees, chlorophyll content of the leaves, length of terminal growth, formation of fruit spurs, set of fruit, and yield and quality of fruit."

CATTAIL PROBLEMS SOLVED

Out in the Pacific Northwest, cattails are being killed successfully by applications of "Telvar" weed killer (either the W or the DW formulation) at the rate of 80 pounds per acre. Applied in June in one dense stand of cattails in one to four feet of standing water, the chemical had effected a 99 per cent kill by September. There was also considerable kill outside the treated area.

WORK CLOTHES OF "ORLON" AND RAYON

PROMISING LONGER WEAR ON THE FARM

The use of man-made fibers in work clothing now offers advantages in long wear and easy care which should prove of real importance in the daily round of farm work.

Recently a line of work trousers and jackets made of 90 per cent "Orlon" acrylic fiber and 10 per cent rayon has been introduced following extensive tests which showed this fabric could "take it" when worn on a series of tough and messy jobs.

Because "Orlon" has resistance to damage from acids, for example, service station workers found these work clothes stood up much longer on jobs necessitating handling of storage batteries. Likewise, on a number of jobs, oil and grease stains were found to be easily removed by either washing or spot-cleaning.

Other plus values demonstrated by clothing of this blend of "Orlon" and rayon are also of interest from the standpoint of farm work. The fabric provides more than usual warmth for its weight. It can be laundered economically at home with no special washing care required. It resists damage from moths and mildew. The tough synthetic fibers do not tend to snag and rip readily. Likewise there is less wear from abrasion. When pressed, the clothing holds its crease longer than fabric of natural fibers. When wet, it dries more readily.

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NEW PUSH-BUTTON PRODUCT

TO SHOO AWAY BIRD PESTS

Do you have starling problems? Do pigeons pester you? Or maybe you live near the ocean and the gulls do a mighty messy job of painting the barn roof!

Whatever your beefs about the birds, you can humanely but firmly discourage their roosting around your home and other buildings on the place with the help of a new aerosol product.

Developed by an Illinois laboratory, this bird repellent has been used successfully for a number of years in a form dispensed from a caulking gun for outdoor industrial maintenance work. The aerosol product, at the push of the button, lays down a ribbon of foam on places where our feathered friends are likely to light. This gelatin compound is said to be harmless to birds, but so disagreeable underfoot that they avoid it as they would a cat.

The repellent is effective for a year or more after application, doesn't wash off, and is not dissipated by sunlight. It will cling to any metal, hard stone, wood, or other building material without staining, and shortly after application blends in with the color of painted surfaces. From a safety standpoint, the manufacturer says it is nonflammable, odorless, and non-toxic to humans.

THE ROTS, RUSTS, BLASTS, AND BLIGHTS THAT BESET US

By Dr. James G. Horsfall, Director
The Connecticut Agricultural Experiment Station

The title of this paper sounds as if the roof were about to fall in on us. It sounds as if all of our crops either have or are about to have some dread disease that might jeopardize our food supply. Actually, of course, the situation is not so dreadful. The plant diseases that beset us are not so devastating now, thanks to modern methods.

I propose to tell you something of the famous plant diseases of antiquity, a few of which have actually altered the course of history. Then I would like to discuss briefly how the scientific research man goes about investigating a disease in order to bring it under control.

If you are over 40, you are thoroughly familiar with the chestnut blight that swept through New England, after having been found in the Bronx Zoo in 1904. Within 10 years the disease had spread clear north into New Hampshire and south and west to Albermarle County, Virginia, and it has long since killed essentially all the native chestnut trees in the United States. If you are under 40, you have heard your fathers or your grandfathers talk about what a happy time they had in their childhood going out searching for chestnuts in the fall and roasting them over the fire during the winter.

If you are a conservationist or interested in the forests, you are well acquainted with white pine blister rust which also was first discovered in the vicinity of New York City and which has spread through most of the white pines in America. The most recent new disease to sweep across New England is the Dutch elm disease which has punched so many big holes in the beautiful canopy of elms overhanging the streets of our towns and cities.

These are modern diseases that most of us know quite well indeed. Perhaps the most famous disease of antiquity is the rust on wheat. The ancient Israelites knew all about wheat rust. They called it blasting or mildew. The forty-first chapter of Genesis, discussing the period around 1700 B.C., says "And Behold, seven ears, (that means heads of wheat) withered and blasted with the east winds,..." Six or seven hundred years later according to Deuteronomy, Chapter 28, the Bible says, "The Lord shall smite thee with consumption and with a fever and with blasting and mildew" if you do not obey the commandments of Jehovah.

We note a very interesting happening in the agricultural history of New England. The colony of Connecticut in 1726 passed a law specifying that barberries must be eradicated in the vicinity of wheat fields, and the General Court (legislature) set a fine of 20 shillings for failure to kill out the barberries, and a further fine of 10 shillings per month until the barberries were eradicated.

It was not until 150 years later that the great German plant

pathologist DeBary discovered that wheat rust actually lives over winter on the barberry plant. Without the barberry plant to support it during the winter months, the wheat rust dies. This indicates the remarkable perspicacity and keen observation of the practical wheat grower of long ago.

The barberry law initially promulgated here in Connecticut in 1726 might in some ways be considered as altering the course of history. As far as I know, it was the grandfather of all laws specifying that it is the duty of the State to protect people from the consequences of pestilence. It was the first quarantine law.

There is another very interesting bit of history which shows the impact of a plant disease on civilization. When the English colonists came to America, some settled in New England, and others in tidewater Virginia, Plymouth and Jamestown being settled within a few years of each other. Undoubtedly, both groups of immigrants brought wheat with them, and they both found the Indians growing corn. The wheat rust disease, however, acted differently on the wheats in the two colonies, just as it does today. Wheat rust is a much more serious disease in warm, moist climate than in cool climates. It was to be expected, therefore, that wheat rust proved much more damaging to the Colonial crops of wheat in Virginia than to those of New England. It is probable that settlers of Virginia found wheat unprofitable on account of rust whereas the settlers of New England found wheat a profitable crop.

It seems to me quite likely that wheat rust explains today's difference between the carbohydrate diets of the southern and the northern United States. Bread, we say, is the "staff of life." In the South bread means corn bread. In the North bread means wheat bread or perhaps even rye bread.

Now you may be thinking that wheat is grown in some parts of the southern United States -- in Texas and Oklahoma. The explanation for this is that wheat rust is severe only when warmth is accompanied by moisture. Hence, wheat rust does not make the crop unprofitable in the dry Southwest as it does in the humid Southeast.

The relation of moisture and warmth to wheat rust has also resulted in some interesting dietary habits in Europe, and in turn in the development of a scourge known as St. Anthony's fire.

England, like New England, is relatively cool and damp, except more so. Central Europe is moist and warm like Virginia. The Mediterranean coastal region, however, is warm and dry, more like Oklahoma and Texas.

Thus, wheat grows in England and in Italy -- in England, because the climate is a little too cool for best rust development -- in Italy, because the climate is too dry.

Similarly, Central Europe like the southeastern United States must depend upon another source of carbohydrate. Usually this is rye. I am dealing, of course, with the pre-potato diets of Europe.

The introduction of the potato changed all this as we shall see later.

Let us see how St. Anthony's fire was related to this interesting distribution of food plants brought on by the action of wheat rust. St. Anthony's fire was a strange malady that afflicted people. Like the plague, it struck down large numbers of people but, unlike the plague, it was not "catching." The characteristic of the disease was the raging fever that gave the disease its name -- St. Anthony's fire. In the Middle Ages it was supposed that the disease could be cured by the intercession of St. Anthony. The fever led to mental failure and often to death. The victims suffered initially with nerve tingling in the feet and hands. They might lose the sense of touch. Then gangrene would set in and the extremities might have to be amputated.

This peculiar disease occurred mainly in Central Europe, seldom in Italy or England. In other words the disease was coexistent with the occurrence of rye. It occurred where wheat could not be grown on account of rust.

As early as 1630 the French physician, Thullier, recognized that St. Anthony's fire was caused from eating rye infected with another plant disease called ergot. Ergot, like wheat rust, liked the warm humid climate of Central Europe. It did not attack rye seriously enough to curtail its yield disastrously but it did produce enough diseased kernels to contaminate the flour for bread.

St. Anthony's fire began to decline in the eighteenth century and was only occasionally serious in the nineteenth century. This decline in severity of St. Anthony's fire was due to the rise of the potato as a source of carbohydrate in Europe. People began to eat potatoes and reduce their use of rye. This had a salubrious effect on St. Anthony's fire but it led inevitably to one of the most devastating famines of modern times, for which a plant disease was again the cause.

Sir Walter Raleigh, visiting in Virginia in the early part of the seventeenth century, discovered the Indians cultivating a plant, the name of which he translated as potato. He took it to Europe where it remained a botanical curiosity for a long time. Eventually the people began to eat it in some volume and the crop spread rapidly across Europe. The peasant farmer of Europe soon discovered that the potato would produce more carbohydrate per acre than either rye or wheat. Slowly in some areas, rapidly in others, the potato replaced the cereals which had been the staple diet of the white man since the dawn of history. Ireland was so densely populated in the early part of the eighteenth century that the potato was a godsend to them. The first thing anybody knew Ireland had almost ceased to grow cereal of any kind and was depending almost exclusively on the potato.

Then a new disease of potato appeared in Central Europe. It was a nasty disease; it made the leaves suddenly turn water-soaked, slimy, rotten, and black. That wasn't such a bad symptom except that the fungus that caused the disease spread from the leaves into the tubers and caused them to decay with a very curious and unusual sort

of hard rot. The disease, which we now know as late blight, spread with lightning rapidity over Europe and appeared in Ireland in 1844. We might describe its catastrophic attack on Ireland in the words of an eye witness, Father Matthews, who says "On July twenty-seventh I passed from Cork to Dublin, and the doomed plant bloomed in all the luxuriance of an abundant harvest. Returning on August third, I beheld with sorrow mere wastes of putrefying vegetation."

In the seven days mentioned by Father Matthews, the stage was set for a famine in which a quarter of a million people actually starved to death from slow malnutrition and a million and a half emigrated, chiefly to the United States. Essentially the entire potato crop of Ireland was wiped out.

Let us turn now and consider why the roof is not going to fall in on us right now with plant diseases. Let us consider some of the science of plant pathology and some of the scientific work that has gone into making plant pathology a modern profession.

Let us consider briefly what causes plant diseases. We very glibly say these days that plant diseases are caused chiefly by fungi, and we all pretty well understand that a fungus is a small thread-like microbe that we can see quite easily under the microscope. How did we arrive at this simple-sounding conclusion?

It so happens that a Dutch lens grinder, named Leeuwenhoek invented the microscope the latter part of the seventeenth century. Some hundred years after Leeuwenhoek described his microscope, an Italian, Fontana, in 1766 examined diseased leaves of wheat and found the microscopic fungus which we today call Puccinia graminis. Fontana, however, could not conceive that these microscopic bodies that he saw were the cause of wheat rust. He decided that they were excrescences growing out of the diseased tissue; in other words, they were a result.

Ten years later Tillet, the master of the French mint, who was an amateur plant pathologist on the side, was working with another ancient disease of wheat called smut. Tillet took Leeuwenhoek's microscope and discovered the fungus of the wheat smut, but he also tended to look upon the fungus as the result of the smut rather than the cause thereof. Later, however, he changed his mind because he was actually able to take small spores of the fungus, mix them up with healthy wheat and make the wheat come down with the disease. This is probably the earliest experimental production of any disease, plant or animal, on record. We might pause for just a second to note that this was almost an even 100 years ahead of Pasteur and his famous demonstration of anthrax in sheep, normally recorded as the first demonstration of the germ causation of disease.

The critical consideration in deciding about the cause of a plant disease is whether or not one can produce the disease experimentally. This is the hard core of the science of plant pathology.

With a brief digression, one might say, however, that several plant diseases are now known which are caused, not by fungi, but by bacteria which are too small to be seen with Mr. Leeuwenhoek's

microscope. The discovery of bacteria had to await the arrival of an improvement in the microscope, called the oil immersion lens. As soon as the oil immersion lens was invented, we could find bacteria in the diseased tissues. Once observed, the bacteria could be isolated like the fungi, grown in pure culture, inoculated into plants, re-isolated and compared with the original, thereby proving, that bacteria produce plant disease.

Once the importance of bacteria was settled there was still a residue of diseases which were "catching" like other diseases but which were not caused by either bacteria or fungi. Techniques had been devised by then for inoculation and experimental production of disease, and it could be shown that the disease could be transferred from plant to plant but no "causal organism" could be found. It was suspected then that the "causal organism" was ultra-microscopic and it was labeled by the old term, virus, which originally meant poison. But virus has now come to mean a cause for disease that cannot be seen with the conventional optical microscope. In the middle of the 1930's, the Radio Corporation of America invented a new kind of microscope depending upon electrons. It is called the electron microscope and will magnify things several times greater than the ordinary microscope. With this machine, viruses can now be seen; we know about how big they are, and can make out something of their characteristics and structure. We don't know yet whether these things are living organisms like bacteria and fungi or non-living proteins, or just what they are.

How about these spray materials we hear so much about these days to combat the rots, the rusts, the blasts, and the blights that beset us? The farmer's spray shed or the gardener's garage is beginning to look like a drug store, with all varieties of agricultural drugs now available to fight the diseases and the pests of plants. We know these things under trade names, but chemically they are called ferric dimethyldithiocarbamate, disodium ethylenebisdithiocarbamate, trichlorothiohexahydrophthalimidine, 2,3-dichloro-1,4-naphthoquinone, and 2,6-dinitro-4-caprylphenylcrotonate. These are jaw-breaking names, but they are also fungus-breaking compounds. Without them, it is conceivable that we might succumb to the rots, the rusts, the blasts, and the blights. By and large, these new fungicides could never have been developed ahead of the knowledge of the role of the fungi in the causation of plant disease. We know that these compounds kill the fungus which causes the disease. It makes no difference whether the climate is wet or dry, hot or cold; as long as we can kill the fungus, we can control the disease.

Today, plant disease history is in the making. The exploration of compounds to be applied to plants to kill the fungus lurking there has reached a high state of perfection. A very large number of compounds are available and more are becoming available every day. This excellent work will keep on.

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Editor's Note: The above article is excerpted from an address by Dr. Horsfall at the 1954 Connecticut Agricultural Experiment Station field day.

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EXPERIMENTERS' NOTATIONS

A Round-up of Data from Across the Nation

* *

A. H. Walker, extension range specialist at Texas A & M College, reports promising results from soil treatments with "Karmex" W herbicide to kill post and blackjack oaks. One-fifth pound active ingredient in a gallon of water applied around the base of the trees gave a good kill, although one or two years were required for complete results. Untreated trees ten feet or more away were often affected, it was observed. A gallon of solution will treat about 25 trees, at an average cost of about three cents per tree.

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Cost studies in Mississippi on the removal of weeds from cotton show that hand hoeing costs from $15 to $20 an acre. For the past five years, studies on the use of chemicals for control of weeds in cotton have been carried on in this state. Only approximately 100,000 acres of the crop have been treated, but it is estimated that the saving to farmers was on the order of $800,000 for a single year. Potentially, the use of herbicides could reduce the production cost of cotton in Mississippi by 20 million dollars annually, if all acreage in the state were treated.

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What agricultural problem interests folks the most? Extension agents throughout the country have good evidence that insects and their control are the subject of more inquiry than anything else. During the growing season, more than a third of all the questions asked of county agent staffs concern insects. The year around, insect questions average about 17 per cent of the inquiries answered by the extension service people.

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Phony peach disease, a virus infection attacking commercial peach orchards, is a serious threat to the peach crop in several southeastern states. Reports indicate it is now causing losses of more than a million dollars annually in Georgia and is apparently increasing in seriousness in South Carolina. In the latter state, experiment station entomologists have declared that all wild plum bushes growing within 300 yards of peach orchards should be destroyed, since a survey shows that 40 to 50 per cent of the wild plums in the state are infected with phony disease. One of the best ways of killing the wild plum trees, according to South Carolina authorities, is to spray them with a pound of "Ammate" weed and brush killer dissolved in a gallon of water, when trees are in full leaf.

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THIS IS DU PONT

The Story of
FARM CHEMICALS

E. I. DU PONT DE NEMOURS & COMPANY
WILMINGTON, DELAWARE

FOREWORD

Millet's "The Gleaners" typified old farm methods

". . . to field and plain . . . the massive thrust of technology."

In the bright days of summer, the harvest creeps northward across the American land, luxuriant, rich and abundant. From field, meadow, stock-lot and orchard, its incredible bounty flows, making the American people the best fed race on earth.

Each American, each year, uses the output of 7.4 acres of land to fulfill his needs. A Japanese is fortunate to have for himself the fruits of less than a quarter-acre.

But more land and the fertility of the soil give only part of the answer. The real difference is that the American farmer, unlike his brothers in the world's more backward areas, brings to the furrow the massive thrust of the force known as technology. It is a happy addition. If today the American continent were called upon to support its teeming millions with the tools and methods of a century ago, this would be a wretched land, rivaling China or India in the poverty and misery of its people.

For it is technology, not social protest, that has brought to the American farm its vast productivity and fruitfulness. The internal combustion engine outdoes the work of armies of men, no matter how heroic or industrious. A single chemist employing the advanced techniques of science provides to the farmer the equivalent of a whole township of workers, at the cost of a few cents.

It is in the agricultural field, indeed, that American industrial technology finds its greatest challenge and its greatest promise. Much of the world's disquietude springs from the stark and elementary realities of hunger. Too often, in the course of history, men have tried to fight want with the clangor of arms or the weak and dispirited sharing of a common impoverishment. Too often, hunger has been the hinge which swung men to surrender their own liberties for a meager and dwindling security.

Perhaps, some day, in the example of an abundant America, all the world will see that its salvation lies elsewhere; that it rests with those ingenious forces which, like technology, can flower only under the sunlight of a universal human freedom.

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PRODUCTIVITY OF U. S. FARMER WHO GROWS ENOUGH FOOD FOR HIMSELF AND 14 OTHERS IS SYMBOLIZED BY JOHN D. BURKHOLDER

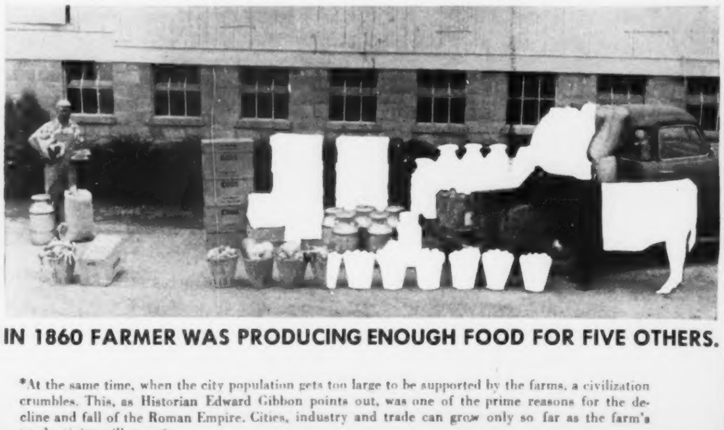
MAN AGAINST THE SOIL

The earth's yield writes our history

The story of man in his rise from savagery to civilization is the story of his struggle to wrest his food from the soil. For untold millennia his capacity to sustain life rested on his own labor and the fruitfulness of the earth. If he was unable to work, he perished. If the soil resisted, he moved elsewhere in a continual migration over the earth.

When each man can raise only enough to feed himself, then all productive effort must go to the raising of food. Thus, a valid yardstick of civilization's progress is the extent to which the farmer's productivity permits larger and larger segments of the population to use their skills in other fields.* Here the

BLOCKED-OUT AREAS SHOW ADVANCE SINCE 1820 ON U. S. FARM.



IN 1860 FARMER WAS PRODUCING ENOUGH FOOD FOR FIVE OTHERS.

*At the same time, when the city population gets too large to be supported by the farms, a civilization crumbles. This, as Historian Edward Gibbon points out, was one of the prime reasons for the decline and fall of the Roman Empire. Cities, industry and trade can grow only so far as the farm's productivity will permit.

FOR EACH UNIT OF FOOD HE PROVIDES HIMSELF, LEFT, HE SUPPLIES 14 ADDITIONAL UNITS, RIGHT, TO FEED OTHERS.

U. S. farmer has wrought miracles. In 1800 he was feeding himself and meeting only one-third the needs of one other person. As the photographs on these pages show, the American farmer has increased his productivity to the point where, today, he feeds himself and 14 others. This paralleled an enormous rise in population – an increase which each year is adding to the U. S. census rolls the equivalent of the entire population of Connecticut.

In Colonial times, farmers made up 85 per cent of the U. S. population; today they account for only 12 per cent, by far the lowest percentage in the world. (By comparison, 60 per cent of the population of Russia is today engaged in farming, suggesting the thin edge which separates starvation from subsistence in that country.) But there is small wonder that the U. S. farmer is the most productive and best rewarded husbandman on earth. The wonder is that he has done so much in so brief a time. For in the last 75 years, he has made greater progress than in recorded history's 7000 years.

IN 1900 HE WAS ABLE TO SUPPORT AN ADDITIONAL EIGHT PEOPLE.

IN 1940 HIS PRODUCTIVITY SERVED ELEVEN OTHER PEOPLE.

FERTILE NILE VALLEY, A CRADLE OF CIVILIZATION IN MIDDLE OF STERILE DESERT, IS STILL FARMED BY ANCIENT METHODS.

THE OBSTACLES

Despite great advances, the ancient and deadly plagues are still with us

Nature usually is a generous provider, but in meeting the complex needs of man it is often rebellious and uncooperative. The obstacles that face the farmer in his patient attempt to fill his needs are formidable and staggering. If the insects do not decimate his crop, disease may. Weeds may steal the nourishment of more useful plants. If a drought doesn't burn the land, a flood may wash it away. His soil itself may rebel and, worn from overplanting, may produce nothing more than scrub. Or, the wind may carry off the rich top loam leaving nothing but eroded desert. And, finally, man as a laborer – aided as he is with marvels of invention and research – is still a pitiful match for nature run rampant.

When the farmer reflects on these obstacles, there is little comfort he can draw—except one. Every farmer in the history of the world has faced exactly the same problems. The Bible, among other things a remarkable agricultural compendium, discusses the plagues, the famines, the weeds, the droughts, in the same tones of calm exasperation as the farmer does today—as the Biblical quotations accompanying the illustrations on the opposite page indicate. Its resonant declaration that "All flesh is grass"* holds true today as it did then.

Until recently, we have little understood the nature of some of these obstacles and, for that reason, tried to meet them with comparatively crude methods. Although, until now, man has not been able to eradicate any of these obstacles, we have made considerable progress in keeping them at arm's length and restricting the severity of their onslaughts. Now, with greater resources and knowledge at our disposal, we are in a far better position to do something effective about them.

*Thorstein Veblen, that misanthropic critic of the "leisure classes," advanced the remarkable theory that man is by nature a herdsman and his desire for a large green lawn around his house is nothing more than a throwback to the cattle pasture and cattle as symbols of achievement.

FLOOD: The flood was forty days upon the earth. *Genesis 7:17*

INSECTS: I will restore to you the years that the locust hath eaten. *Job 2:25*

FAMINE: I called for a drought upon the land, and upon the mountains, and upon the corn, and ... upon that which the ground bringeth forth. *Haggai 1:11*

STERILE GROUND: Seeds fell ... upon stony places ... and because they had no root, they withered away. *Matthew 13:3-5*

WEEDS: But while men slept, his enemy ... sowed tares among the wheat. *Matthew 13:25*

DROUGHT: The herds ... are perplexed, because they have no pasture. *Job 1:18*

PUSHING THE LIMITS

Our population is growing rapidly, but not so the land that feeds us

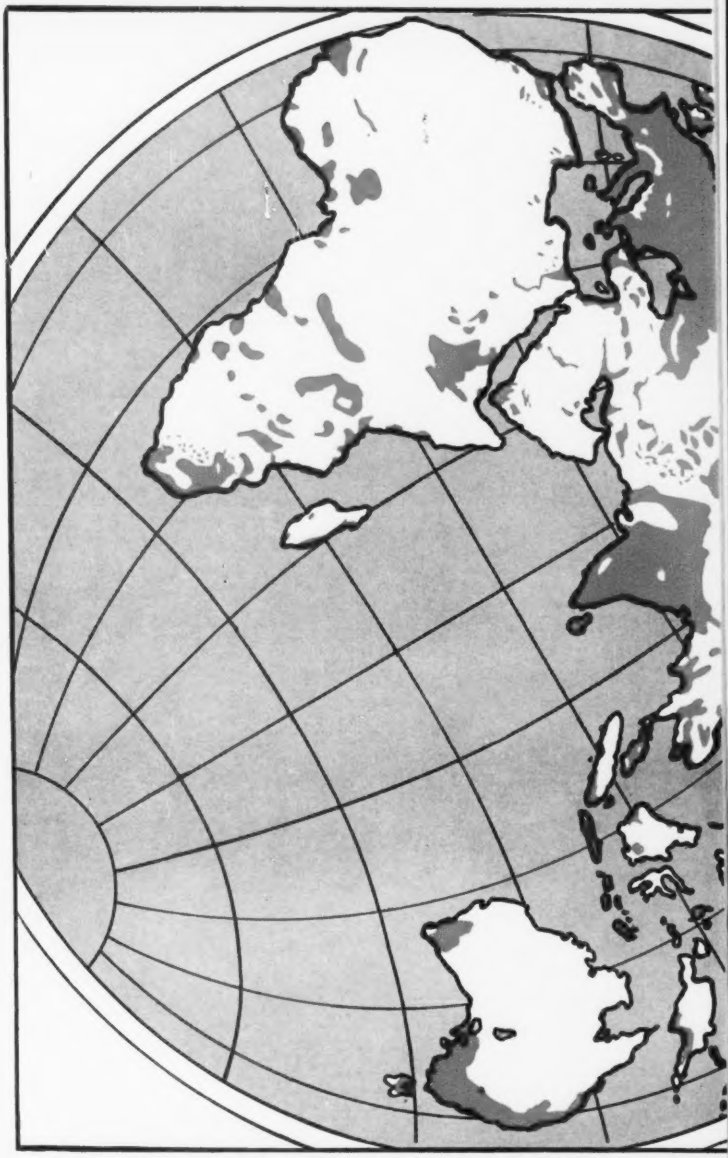
The most important — and stubborn — facts confronting the farmer today are: 1) the acreage of the world on which his crops grow is surprisingly small; and 2) the prospects of adding to it substantially are remote.

The two-and-a-half billion acres now growing the world's food represent but two per cent of the earth's surface. The remainder is covered by water (71 per cent), mountains (3.5 per cent), ice or snow or land which is too wet or dry to be habitable (5 per cent). Twelve per cent is very sparsely settled due to rigorous climate, extreme heat, deserts, jungles and other barriers to comfortable living. The remaining areas (6.5 per cent) consist of forests, hills, cities, rocky land, arid and eroded land, swamps—areas so barely settled or so unfit for cultivation that large-scale agriculture is next to impossible.* Add to this the fact that this tiny but vital patch of land must feed an ever increasing world population — 2,400,000,000 at present and growing at the rate of approximately 18,000,000 a year — and one begins to understand the enormity of the job that must be done.

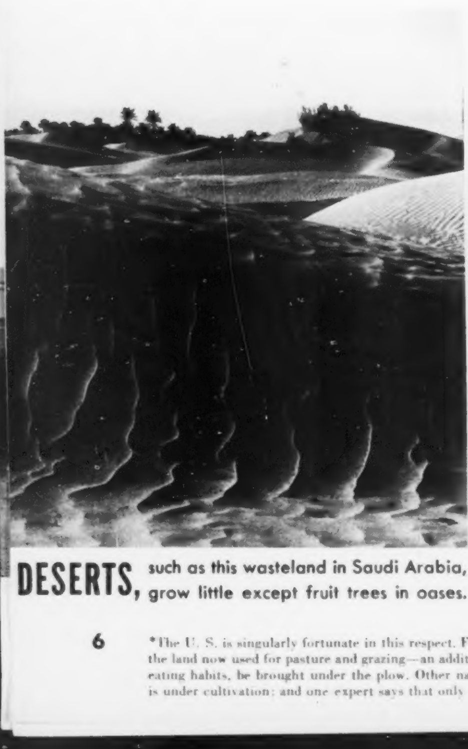
There are tragic overtones. In the last 20 years, the world's food production has edged up a scant five per cent. Its population, however, jumped at least 25 per cent. A different picture prevails in the U. S. where, in the same period, the population increased 18 per cent and its food production rocketed 50 per cent.

Admittedly, heroic and costly conservation, reclamation and irrigation projects can add some acreage, but this will extend our arable area only a fraction. The solution lies in achieving better results in food crops and animal products from the land we now farm.

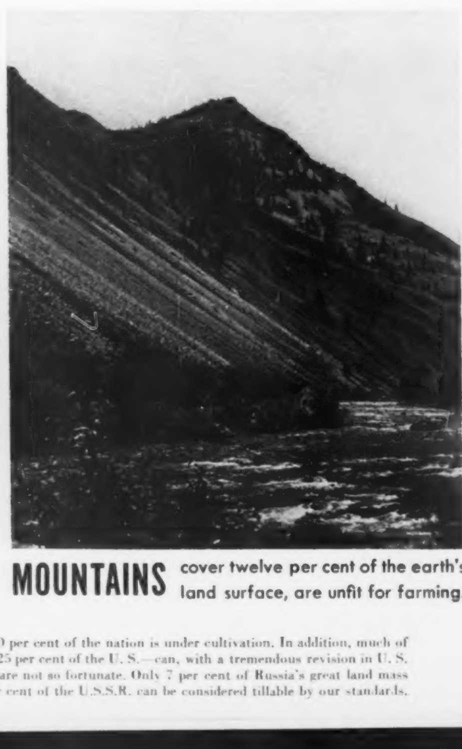
It is to this task that we must apply ourselves and it is in this area where we stand our greatest chance of success.



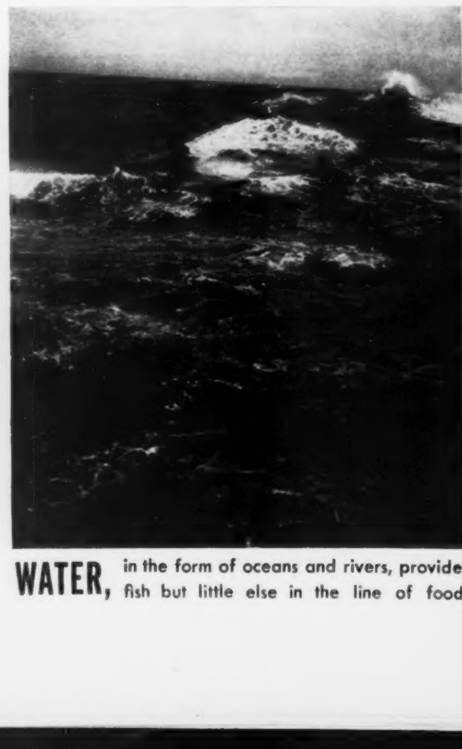
THE CULTIVATED AREAS OF THE EARTH ARE SURPRISINGLY LIMITED.



DESERTS, such as this wasteland in Saudi Arabia, grow little except fruit trees in oases.



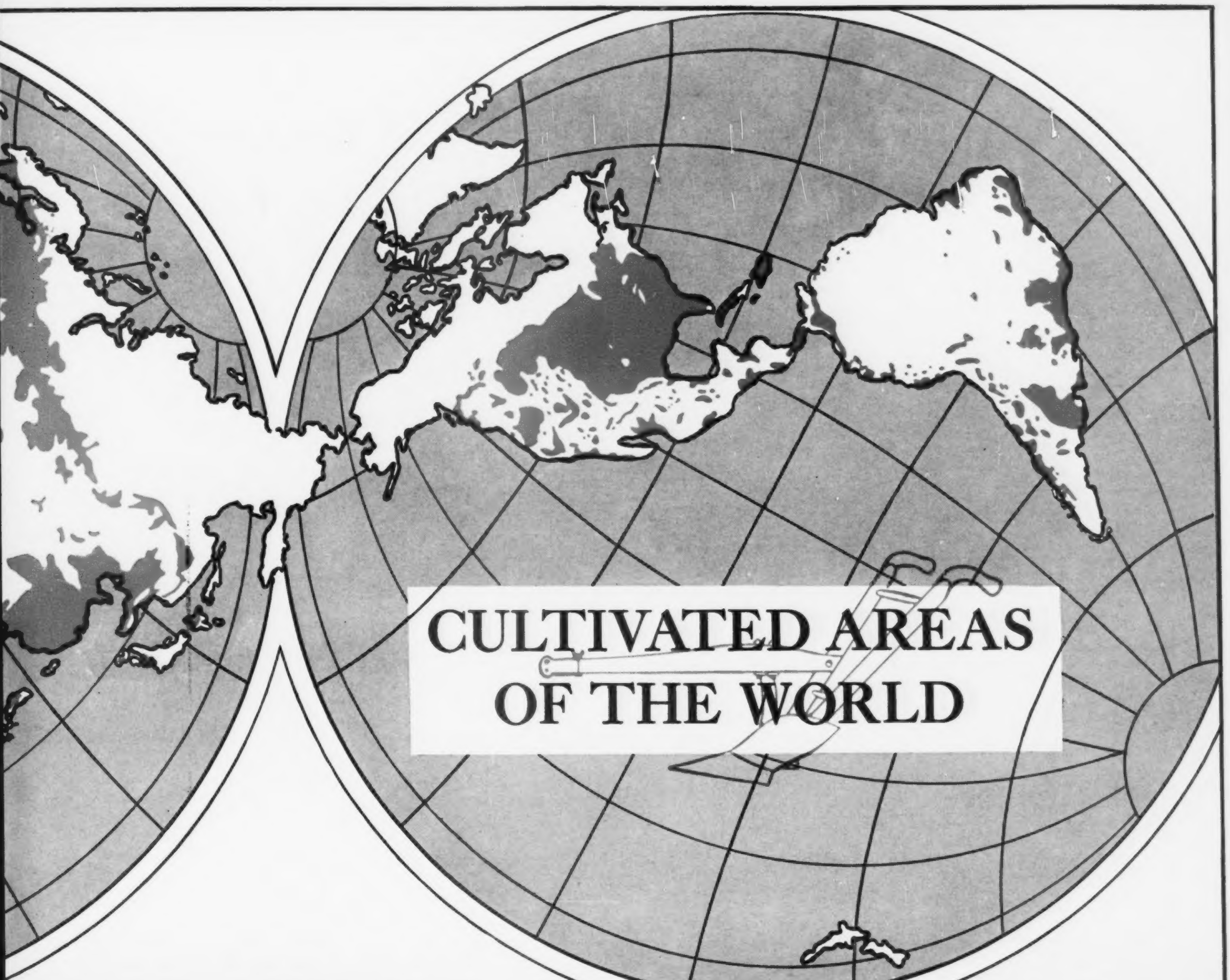
MOUNTAINS cover twelve per cent of the earth's land surface, are unfit for farming.



WATER, in the form of oceans and rivers, provides fish but little else in the line of food.

*The U. S. is singularly fortunate in this respect. Fully 20 per cent of the nation is under cultivation. In addition, much of the land now used for pasture and grazing—an additional 25 per cent of the U. S.—can, with a tremendous revision in U. S. eating habits, be brought under the plow. Other nations are not so fortunate. Only 7 per cent of Russia's great land mass is under cultivation; and one expert says that only 10 per cent of the U.S.S.R. can be considered tillable by our standards.

CULTIVATED AREAS OF THE WORLD

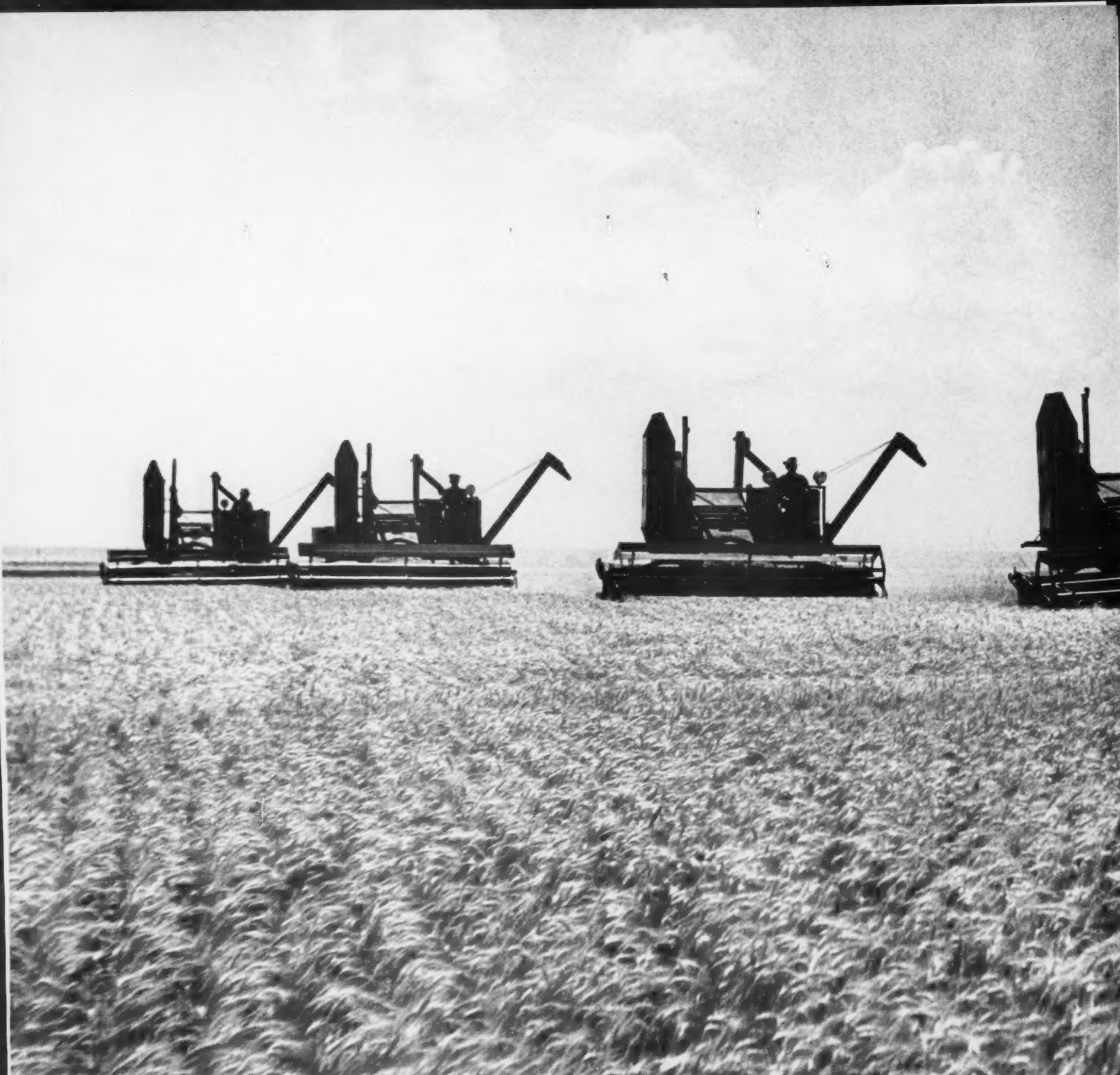


AS SHOWN GENERALLY IN GREEN ON MAP, THEY AMOUNT TO 8 PER CENT OF LAND AREA, ONLY 2 PER CENT OF TOTAL SURFACE.

JUNGLES may be farmed, but the cost in manpower and money would be prohibitive.

ICE AND SNOW cover vast areas, can never be farmed with present methods.

BAD SOIL, such as rocky land, can be farmed only with the greatest of difficulty.



LIKE A COLUMN OF SHIPS MOVING ACROSS THE SEA, THESE COMBINES SYMBOLIZE MAN'S CONSTANT EFFORT TO FARM MORE

STEEL PLOW of 1830's sliced heavy rich sod of prairies, opened vast area to efficient farming.

BROADCAST SEEDER of 1850's cut sowing time by one-third, spread seed more evenly than hand method.

MOWER, dating from 1822, cut one acre per hour, did six times the work of man with scythe.

EFFICIENTLY. SELF-PROPELLED COMBINES CUT AND THRESH 45 ACRES IN 8 HOURS.

FARM MACHINERY

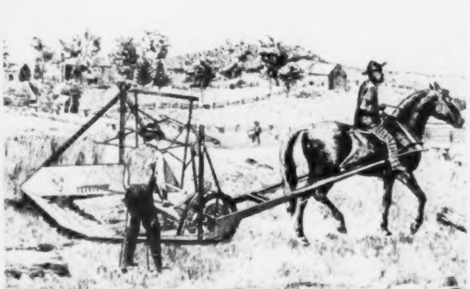
Tools abolished peasantry

The American farmer has not been forced to face his problems alone. At his side, from the early days of this country, have been the scientist, the engineer, the inventor. Growing and flourishing in an atmosphere of freedom, American industrial enterprises have provided the farmer with a dazzling array of helpful servants. These range from the steel plow in the 1830's, which allowed the farmer to open the rich bottom lands of the Midwest, to the awesome and fantastic machine called the combine which harvests, threshes and cleans grain all in one operation.

This was not always the case. Colonial American farmers used the same methods and tools as the cultivators of the Hanging Gardens of Babylon. From the year 3000 B.C. until the 19th century A.D. the only significant advances in agriculture were the cradle and scythe – first seen in the U. S. in 1790 – and the horse collar.*

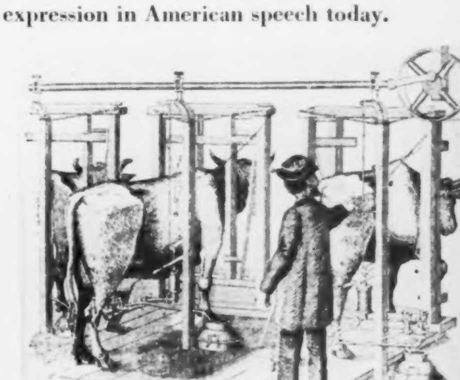
Starting in the second third of the 19th century, however, came an outpouring of inventions which transformed the face of this country and the world. In quick succession came the steel plow, the reaper, the grain drill, the thresher, the tractor, the combine, and countless others. The farmer's load became less oppressive, the man with the hoe was on the way out. In 1830, for instance, the human labor factor needed to produce one bushel of grain was three-and-a-half hours. By 1896, even before the introduction of the tractor, the time had been slashed to 10 minutes.

In a few decades, U. S. industry, through its inventive genius, has contributed the tools and methods which have revolutionized agriculture. And, along with these, it has also brought a high level of prosperity to America's farmers, lifted the burden of labor from their backs, made the dreaded word "famine" an archaic expression in American speech today.



REAPER of 1830's cut harvest time in half, made possible the great wheat production of Midwest.

TRACTOR of today stems from 1876 steam traction engine, which outworked horse-drawn equipment four to one.



MILKING MACHINE, developed from crude beginning in 1880's, founded modern dairy industry.

*Introduced about 1000 A.D., some historians claim it is as great an agricultural advance as the invention of the wheel. Its use spurted when some countries, including Ireland, passed laws against hitching loads to horses' tails. In this country, even as late as the 18th century, there were regulations proclaiming that "Hitching ye animals by ye tails is a cruel practice and is therefore forbidden."

CHEMICAL PIPE-ORGAN, a counter-current distribution machine whose 100 intricately connected test tubes help separate complex mixtures into individual components, typifies modern research tool used to find farm chemicals. Biochemist J. Bradley Harrison operates it at Du Pont's Stine Laboratory.

CHEMICAL SCIENCE JOINS THE BATTLE

Now the heaviest guns of all are brought to bear on the problem of halting nature's onslaughts and increasing our farm abundance

The inventions on the previous pages help relieve the farmer of many of his burdens and permit him to cover greater areas. They are, however, only the first step in solving his most pressing problems: overcoming the ravages of nature and getting the fullest yields from the land he farms.

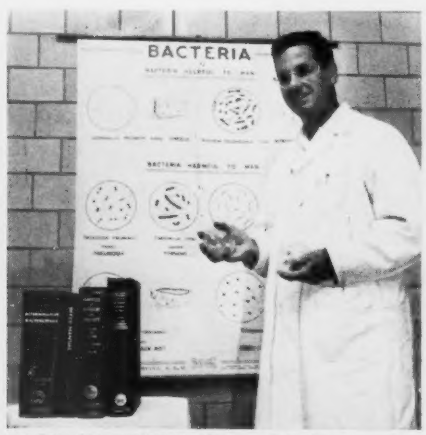
For this job, a new force has been added, more powerful in its long-range implications than anything before. It is the chemical and biological laboratory. The scientist reasons this way: if weeds, insects and disease can reduce an acre's yield by 50 per cent – and they often do – then eliminating the crop loss will double the yield. One acre then does the work of two.

Here, the chemical industry has made notable contributions. Its products enrich the soil and the crops; they strike back at the insects and pests which plague the farm animals and crops; they limit the crippling effects of animal and plant disease; they attack and kill the predatory weeds; they improve the diet and health of our farm animals. And they insure the farmer's investment and the nation's food supply.

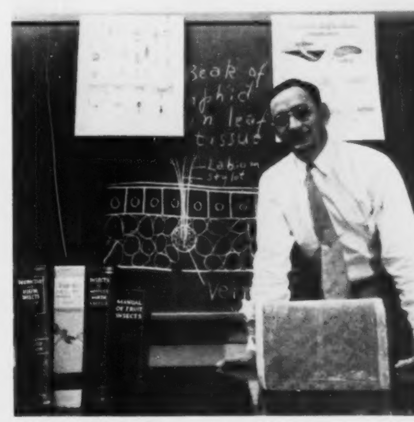
The whole scientific fraternity works with the farmer in this struggle. The industry, employing thousands of scientists, works closely with government agencies, experiment stations and universities. The research budgets are impressive. Du Pont, alone, allocates millions of dollars for agricultural research and maintains a number of experimental farms and a large staff of technical experts.

Agricultural research draws upon the talents of many kinds of scientists, some of whom are shown below. These men produce and evaluate thousands of different chemicals. The scope of their work and the size of industry's investment in it may be seen by one fact. At Du Pont, about one chemical out of each 1500 compounds which are developed in its laboratories succeeds in being of commercial value to the farmer.

SOIL SCIENTIST, Dr. Carl W. Bingeman, examines samples of soils from all parts of the U. S. to see how they react to effects of agricultural chemicals.



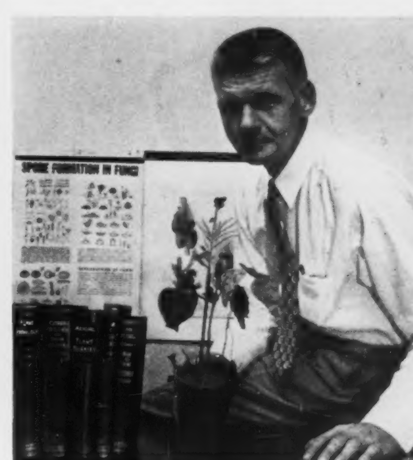
BACTERIOLOGIST, Dr. Conrad E. Hoffmann, raises cultures of bacteria, and studies the effects of different chemicals on disease-causing bacteria.



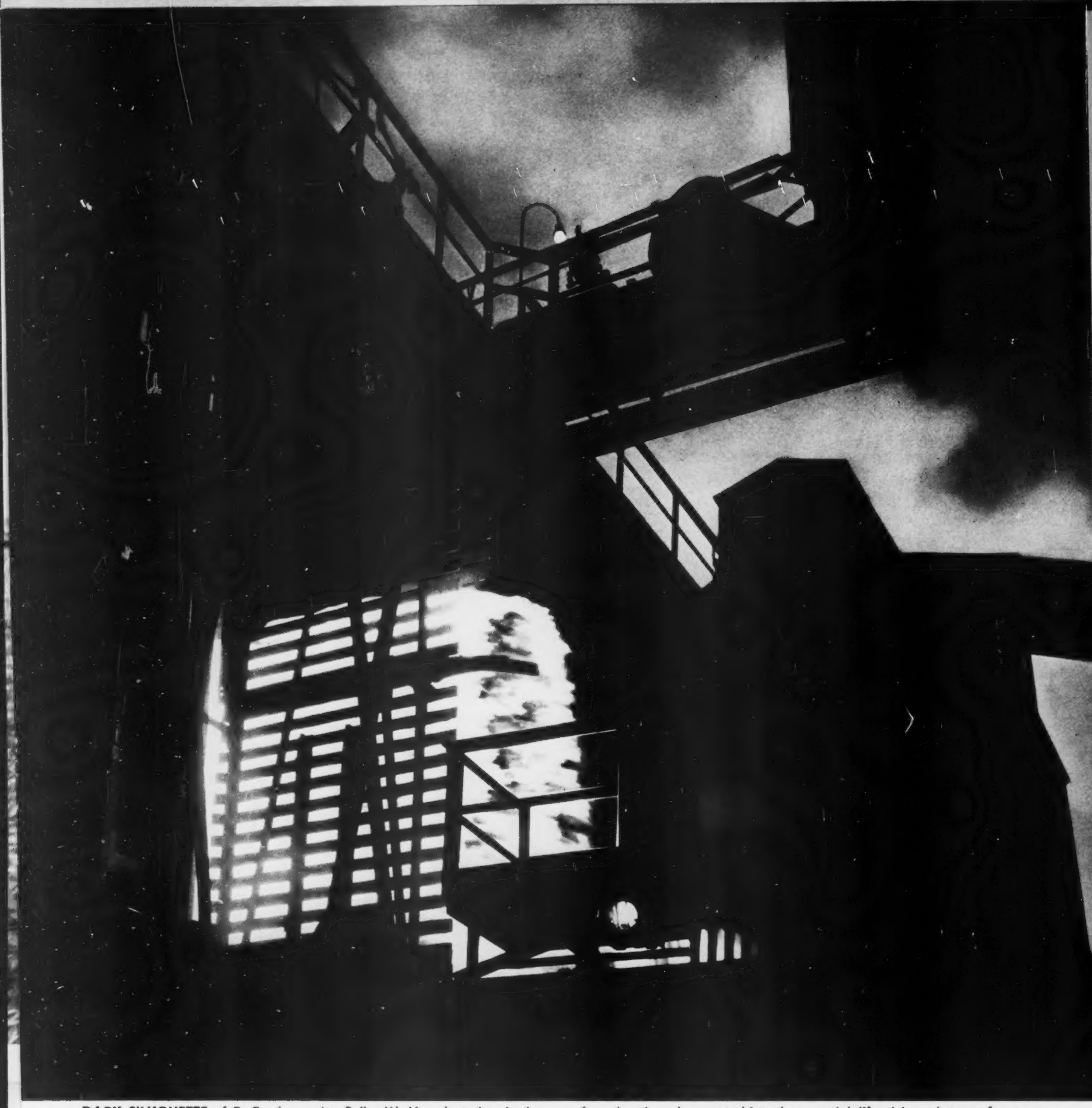
ENTOMOLOGIST, Dr. Silas S. Sharp, conducts intensive studies into nature of insects which attack crops, tests effects of insecticides on them.

PLANT PHYSIOLOGIST, Dr. Richard D. Northcraft, studies cell structure and growth pattern of plants to see how chemicals affect them.

PARASITOLOGIST, Dr. David R. Lincicome, investigates the action of parasites on food-producing animals, looks for chemicals to stop them.



PLANT PATHOLOGIST, Dr. David L. Stoddard, studies the course of diseases which affect plants, investigates chemical compounds to prevent them.



DARK SILHOUETTE of Du Pont's massive Belle, W. Va. plant rises in the night outlined by the glare of huge coke furnaces. Here, nitrogen is separated from the air and converted into the essential, life-giving substance for crops and animals. This development is one of chemistry's most notable landmarks.

FIXED NITROGEN

One of chemistry's great triumphs, it is vital to plant and animal life

Nitrogen is an odorless, colorless gas which is a key element in all plant and animal proteins. Without it, every human being, every animal and every plant on earth would perish.*

It makes up about 80 per cent of the air we breathe. Some 70,000,000 pounds of nitrogen are in the column of air above each acre of land. Despite this, no human being or animal can use any of it, and only very few plants can benefit. To be useful, nitrogen must be "fixed," or combined with another element. And nature sets rigid rules for this.

Natural fixation of nitrogen takes place in the sky and in the ground. Each time lightning crashes, it fixes atmospheric nitrogen which is then carried to the ground, as nitric and nitrous acids, with the next rain.† Soil-fixed nitrogen is made

*Oddly enough, nitrogen, the element which sustains life in the human population, is just as vital for military explosives.

†Some 60,000 tons of nitrogen are fixed each day in this manner, but most of it falls on oceans, mountains, etc., where it does the farmer little good.

available by the action of soil bacteria which work it over until it is ready for its next job – absorption by the plants. Man and animal then get nitrogen simply by eating the plant. Man has another source of nitrogen: he also eats the animals which eat the crops.

For centuries man has known that intensive cultivation impoverishes the soil. This he could see after each succeeding harvest when his soil would yield less and less abundant crops. Desperate, farmers turned to anything – some foolish, some fancy – until they discovered the compost heap, a super storehouse of fixed nitrogen. Why it worked, the French peasant never knew. But it enriched his soil and produced better crops, and wisely, he treasured it.

But it was only at the end of the 18th Century that Lavoisier and others showed that air was a mixture consisting largely of oxygen and nitrogen. From this stemmed investigations which showed nitrogen was basic to healthy soil and healthy plants. But it was being taken out of the soil much faster than it was being replaced. And natural deposits were, at best, a pitiful buffer. Nitrogen starvation of the soil became so severe that as late as 1898, Sir William Crookes, a leading British scientist, stated flatly that unless some way was devised to get nitrogen out of the air and into the plants, those races which depend on wheat for bread would "be squeezed out of existence . . ."

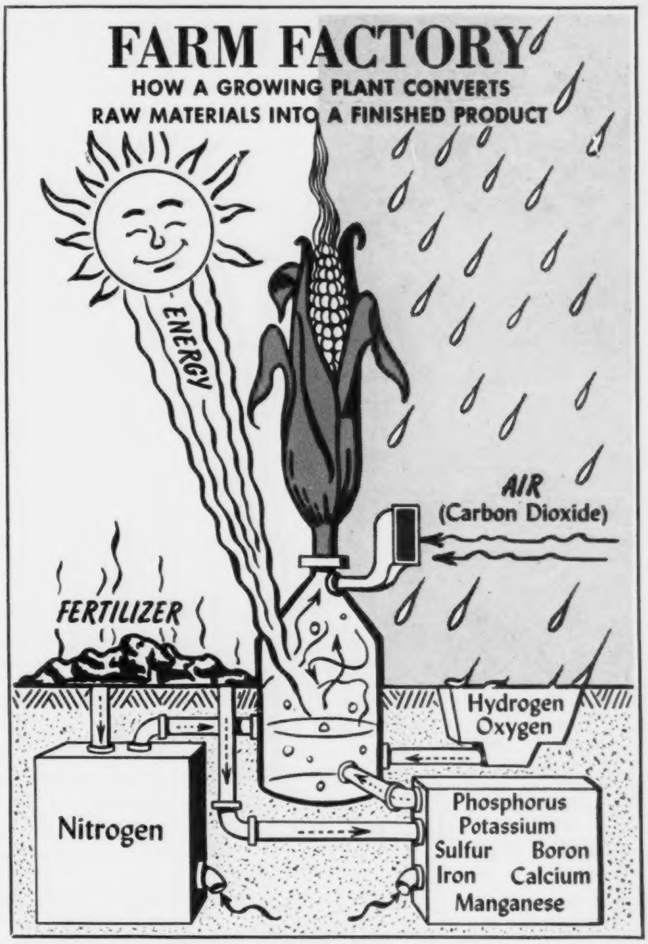
What was needed was an abundant, inexpensive source of nitrogen, independent of the vagaries of ocean transport, price fluctuations, degrees of quality. All this has been the signal contribution of the infant chemical industry which utilized the brilliant groundwork laid by the German scientist, Haber.

Using the sky as its storehouse, the industry separated nitrogen from the other elements, subjected it to fantastic pressures and temperatures and produced "fixed" nitrogen, a development called a ". . . basic achievement upon which rested the advance of modern civilization."

Overnight the U. S. fertilizer business was revolutionized. Ground fish heads and animal intestines were supplemented with tons of scientifically prepared chemical fertilizers. And, behind each ton of nitrogen, stands an industry investment of $250. In 1951, American industry was fixing 1,650,000 tons, and expanding rapidly.

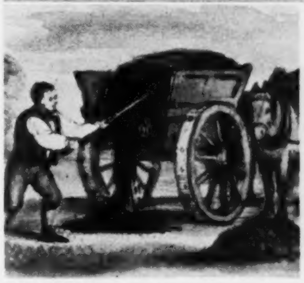
Du Pont was one of the earliest U. S. manufacturers of fixed nitrogen, having acquired a process from the French in 1924. Du Pont invested tremendous resources in men and money to further develop the process to its present high level of efficiency. With this abundant source of fixed nitrogen in the form of fertilizer, Du Pont became a vital part of the U. S. agricultural picture. By 1931, Du Pont, as a pioneer in nitrogen research, was producing synthetic urea, a newer form of fixed nitrogen which was more efficient and convenient. Even more important, urea opened up such promising new fields for agriculture that intense research was immediately started by colleges, experiment stations and Du Pont. Among many important results, two major ones stand out. One was the discovery that nitrogen in the form of urea can be applied directly to the leaves of growing plants. This allows the farmer to pinpoint nitrogen applications, thus using as little as is required when it is most needed. The other was the discovery that urea serves as a source of protein for ruminant animals such as cows. Its use has already caused a revolution in cattle feeding (pages 22-23).

The introduction of fixed nitrogen resulted in a new bond between industry and agriculture which has resulted in an increasing use of chemical fertilizer (a 300 per cent rise from 1940 to 1950) and a welcome increase in soil productivity,

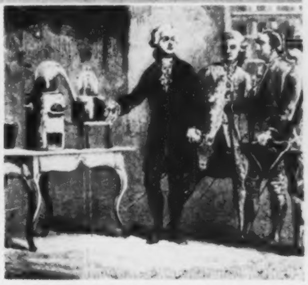


HOW CROPS GROW by utilizing nourishment from the soil and the air is shown in this simplified drawing. Nitrogen, which is of great importance in plant growth, is supplied by fertilizer applied to soil or sprayed onto plant.

THE QUEST FOR NITROGEN:



COMPOST, rich in nitrogen, was used by peasants to replenish soil, but they did not know why.



LAVOISIER, great French chemist, was among first to analyze air, understand the nature of nitrogen.

DEPOSITS of nitrate were found in Chile, but remoteness and need for ocean transport curbed use.

NEWEST METHOD of applying nitrogen is by air or spraying directly on leaves of plants, trees.

A PLAGUE is controlled in Du Pont laboratory test by Entomologist Dr. J. K. Scoggin. Mexican bean beetles destroy untreated bean plant, left. Plant sprayed with insecticide, right, is not affected, but attacking insects are killed.

HORNFLY performs its destruction on principle of jack hammer, drilling into animal, then sucking out blood. Flies can cut milk production 20 per cent.

INSECTS

Ravenous and costly, they eat more than $4 billion worth of crops yearly

In the endless battle of man against insect, the advantage lies all with the pests. They have, in the first place, greater seniority; they have been around for 250,000,000 years; *homo sapiens* for a mere 25,000.

They outnumber man: There are 686,000 species, of which 82,000 insect species and 2600 different ticks and mites flourish in the U. S. They reproduce rapidly: one pair of flies could in a few months, if nothing interfered, lay a blanket of their descendants over this planet to a depth of three feet.

Insects outweigh us: The insect world, by a three to one ratio, outweighs the combined poundage of every human, animal, bird, reptile and fish in the world.

They are ravenous: Last year, in the U. S., they ate their way through $4 billion worth of crops. The boll weevil alone destroyed $1 billion worth of U. S. cotton in a single year.

They are hardy: Despite all of man's efforts, he has not eradicated one single insect species from the earth.

If the situation is to be bettered for the farmer, it is only because man's technical skills have brought notable advances to his defense. Where once he stood helpless in the face of plagues, today he has a vast arsenal at his disposal. A variety of insecticides for a variety of pests helps him keep his crop losses to the figure it now is. Without them, he could hardly survive. Although the farmer hasn't won the battle by any means, he is keeping these hungry and marauding insects at arm's length. And this is the first step toward eventual victory.

CODLING MOTH, or apple worm, is a tunneler, operates like auger bit. It causes as much as 15 per cent crop loss, but is now controlled by DDT.

CORN EARWORM chews through corn much as a meat grinder shreds meat. It also attacks tomatoes and cotton, but is controlled by applications of DDT.

GRASSHOPPER attacks wide variety of crops using principle of heavy-jawed wire cutter or rock crusher. It is one of the most destructive farm pests.

MEXICAN BEAN BEETLE tears its way through food crops the way a scissors rips through paper. It causes annual crop losses of up to $15,000,000.

APHIDS attack vegetables, other crops, kill plants by sucking out their vital juices like vacuum cleaner, cause losses of hundreds of millions of dollars.

DRAWINGS BY RICHARD ERDOES

INSECTICIDES NOW CONTROL SWARMS OF INSECTS, ABOVE, WHICH CAN STRIP A FARMER'S FIELD CLEAN IN A FEW MINUTES.

CHEMICALS MEET THE CHALLENGE

Insecticides are helping the farmer beat back the pests, grow more food

Of the more than 80,000 kinds of pests in the U. S., about 7000 are injurious to crops. They begin their assault the minute the seed is planted, chew through the growing season, attack in harvest, transportation and storage.

The wonder, then, is not how crops manage to survive this attrition, but, rather, how the farmer produces so many things in such abundance. Insecticides make the difference.

From the laboratories and plants of the U. S. chemical industry have come an army of helpful compounds — with some of the longest and most formidable names in the language — to join the farmer in beating back the insects. From 1,1,1-trichloro-2,2-bis (p-chlorophenyl) ethane (DDT) to 1,2,3,4,5,6-hexachlorylcyclohexane (BHC), insecticides keep losses low.

ALFALFA is attacked by many insects including spittlebugs prevalent in Pennsylvania, Indiana, Ohio, Maryland. Chemical control stops these pests.

WHEAT is prey to many pests including Hessian fly, chinch bug Use of chemicals on wheat added 21,000,000 bushels of wheat to bins of one area alone.

TOMATOES are attacked by pin worms, beet leafhoppers, others, but spraying with insecticides has cut losses enormously and saved millions of dollars.

COTTON is attacked by boll weevil and other pests. Chemical spraying has helped reduce loss from $1 billion a few years ago to $250 million.

CITRUS losses to San Jose scale and plum curculio approach $20 million a year, but chemical control has recently boosted production by 100 per cent.

APPLES, hit by 100 different insects including codling moth, which does $31 million damage, could not be grown economically without chemical control.

CORN is hit by corn earworm, corn borer and others, but use of chemical insecticides recently added more than 10,000,000 bushels of that grain to bins.

POTATOES are hard hit by the Colorado potato beetle, but use of chemicals has cut damage considerably and, in some areas, it doubled production.

In just two states – Montana and Wyoming – chemical control of insects recently saved enough pasture to produce an additional 11,000,000 pounds of beef. Insects plague cattle mercilessly, causing sharp drops in milk and beef yield. (Researchers have found up to 15,000 flies on a single bull and 4000 flies on every animal in one dairy herd.) Chemical control of one single cattle pest—the horn fly—increased milk yield up to 15 per cent in one area, and upped beef production at a rate of half-a-pound a day. In addition, pesticides boosted alfalfa seed production in California by 600 per cent in just one year. The list of advances grows longer every day.

The insecticides are applied to the crops in a wide variety of ways, from small hand sprayers, to large tractor-driven jobs, to airplanes.* Wherever they are used, they are saving the farmer time, money, heartbreak. And better things are to come. Scientists are searching every day for new and improved means of stopping insects. No one believes for a minute that we can eradicate all those hardy and prolific bugs from the earth. But, based on the past progress science and industry have made in agricultural research, there is reason to hope that farmers in the future will be given the tools to make the insect problem a nuisance rather than the menace it now is.

*Newest wrinkle: farmers are mixing nitrogen, in the form of Du Pont's "NuGreen," with their insecticide sprays and thus manage to fertilize their crops and protect them from pests in a single operation.

PLANT-DISEASE ORGANISMS ARE CHECKED BY BIOLOGIST RACHEL CLENDINNING IN A DARKENED, CONSTANT-TEMPERATURE

HUNDREDS OF COMPOUNDS, on shelves, were tested by Du Pont before "Manzate" fungicide, held by Laboratory Ass't. Lillian Nagle, was discovered.

PLANT DISEASES

There are thousands of them and they are deadly

Like people, plants suffer from a vast and dismaying roster of disease. A recent compendium of the ailments attacking plants runs to 1192 pages of fine print. Some plants are attacked by as many as 300 different disorders.

Unlike man, to whom most bacterial, virus or fungus infections are disagreeable but not necessarily fatal, a plant once stricken rarely recovers. Last year the mortality rate was such that the U. S. lost $3 billion in foodstuffs. Without chemical help, there is no telling what the loss might have been.*

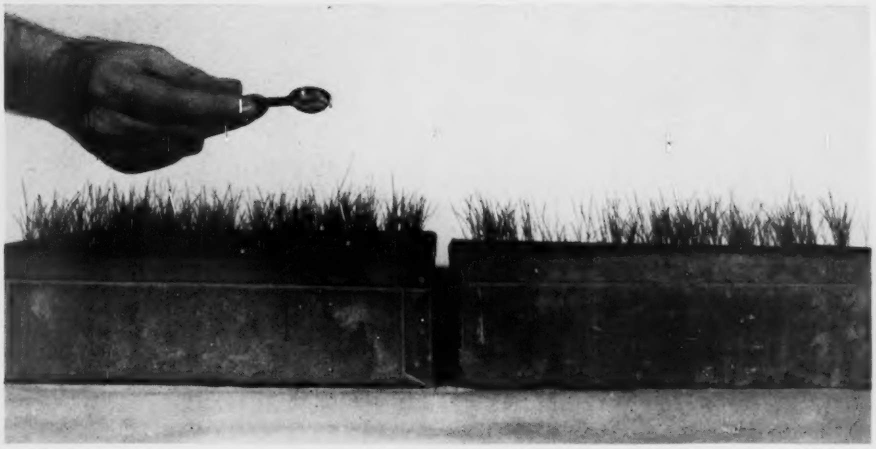
As in the human species, prevention, rather than remedy, is the best therapy. In plants the first step in checking the disease is to treat the seed with disease-

*An example of what a plant disease can do unchecked may be found in the invasion of potato late blight into Ireland in 1845. It destroyed that country's main food crop, resulted in the death of almost 1,000,000 people (12 per cent of the population), and forced the emigration of 1,500,000 others, mostly to the U. S.

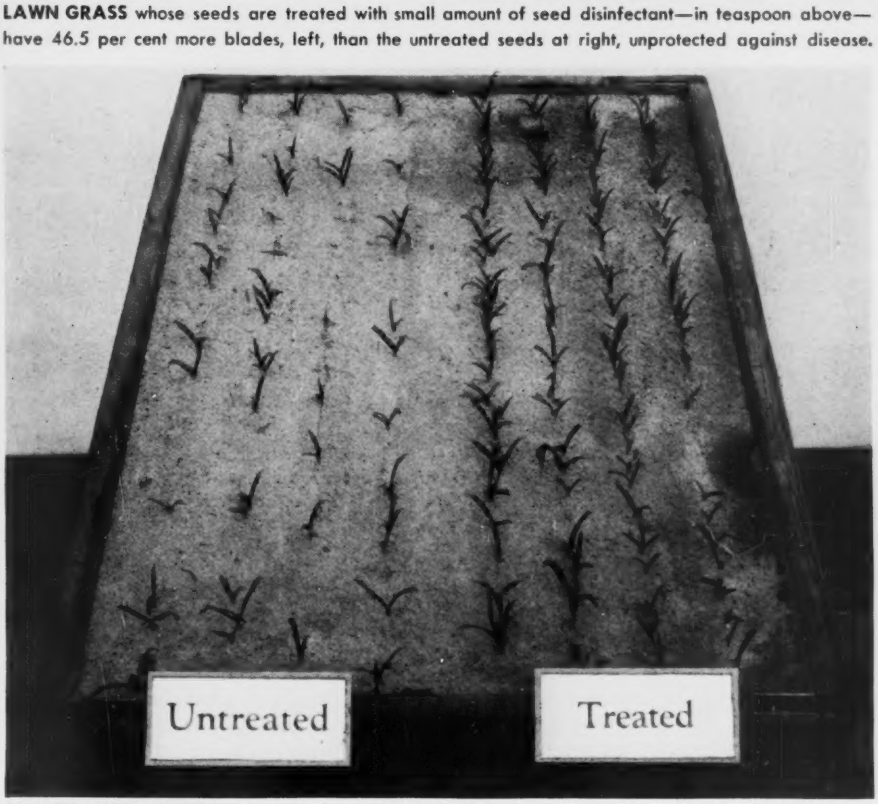
ROOM AT DU PONT'S EXPERIMENTAL STATION.

fighting chemicals. The results are impressive. In Kansas, seed treatment recently saved $28 million worth of grain. And, the success of agriculture's great achievement—hybrid corn—rests on seed treatment. This corn is a very resistant strain once it is above the ground. But the seeds are very susceptible to disease and mortality is high. Seed treatment ended the problem overnight.

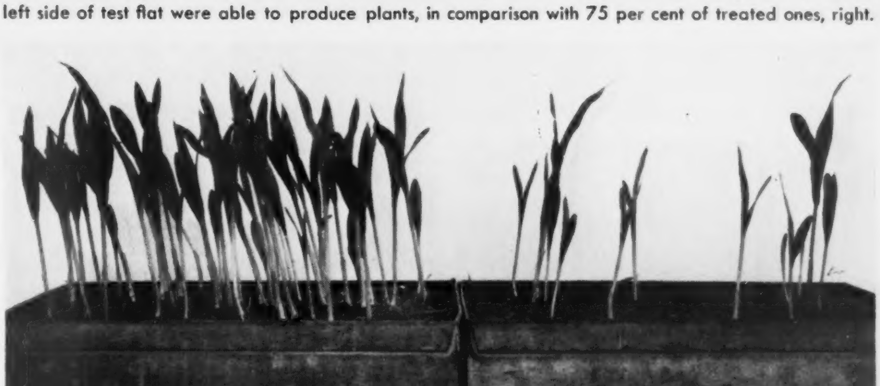
Another contribution is the development of fungicides which kill, or prevent the growth of, plant-destroying fungi. Billions of dollars have been saved by these chemicals, and the future holds promise for even greater success.



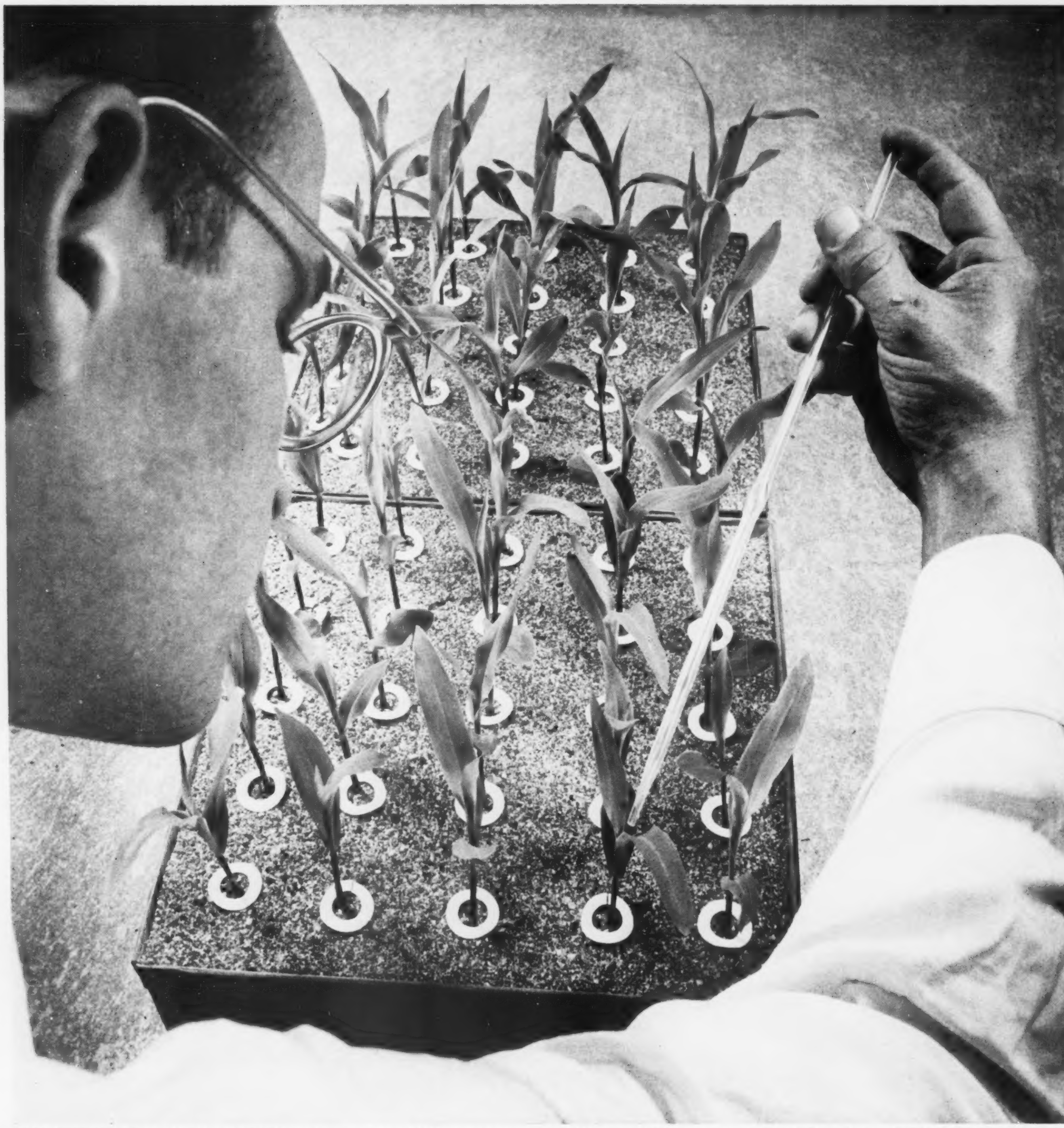
LAWN GRASS whose seeds are treated with small amount of seed disinfectant—in teaspoon above—have 46.5 per cent more blades, left, than the untreated seeds at right, unprotected against disease.



PLANTS GROW BETTER when seeds are treated. Only about 40 per cent of the spinach seeds at left side of test flat were able to produce plants, in comparison with 75 per cent of treated ones, right.



FIELD CORN grows abundantly when the seeds are chemically treated, left, poorly when not. Hybrids and seed treatment have helped corn to grow 100 miles north of the corn line of 25 years ago.



THE EFFECT OF A NEW HERBICIDE WHICH ALLOWS CORN TO GROW BUT KILLS ALL WEEDS IS STUDIED BY DU PONT SCIENTIST.

LAWNS are aided by selective weed killers like 2,4-D, which kills some weeds, lets the grass alone.

WEEDS ARE CRIMINALS

In the underworld of plant life, the lowest of criminal orders are the weeds. They are noxious, economically useless growths which thrive among the more useful plants in such abundance that the food crop is certain to suffer in the absence of adequate policing.

Weeds carry on their nefarious activities in many ways, as the drawings on the opposite page show. The bulk of the damage is carried on in the manner of the common sneak thief. Weeds require far more food than the plants they rob. Since they are usually hardier, they win out by putting out more roots, sending them deeper, and sucking in more food and moisture than useful plants. Last year they drained the vital juices of $5 billion worth of U. S. crops.

For centuries, man has had only one

SMOTHERER in the weed family of criminals carries out its nefarious activity by growing faster than food crops and blotting out needed sunlight.

SNEAK THIEF weed needs more food than crops; sends out more roots wider and deeper, stealing nourishment which should go to the useful crops.

STRANGLER twists and winds its way up the stalks of useful crops, such as corn, until, by sheer weight and food theft, it kills off unhappy victim.

POISONER, such as locoweed and others, contains noxious chemical substances that are very harmful to cattle which may happen to use it for forage.

way to handle this problem: his hands, to chop, pull or hoe. The tractor permitted him to do his cultivating at a faster rate, but it was still only a faster method of hoeing. It remained for the chemical industry to find a less burdensome way to fight weeds.*

A start was made shortly after the end of World War II by 2,4-D, which started out in life as a growth regulant. Researchers discovered that if heavier doses were applied, the plants grew so much that they "grew themselves to death." Most important, it affected some broad-leaved plants—which are usually weeds —but not grassy plants, which include the cereals. Today, a new herbicide, CMU, and a family of related compounds developed by Du Pont, promises even more. Presently used on pineapple, sugar cane and asparagus, it attacks a greater variety of weeds, does not volatilize and drift to adjoining crops, maintains its strength for exceptionally long periods.

Weed control is still in its infancy, but already it has increased pasture values by as much as 20 per cent, reduced the farmer's cost of tillage by 50 per cent.

WEED KILLERS on farm attack broad leaf weeds like thistle and bindweed, but do not harm crops.

*One chemical worker making weed-killers is estimated to equal the efforts of 800 farm workers chopping weeds with the hoe.

WAR AGAINST DISEASE MAKES COWBOY OF YESTERYEAR A USER OF MODERN CHEMICALS. HERE RANCH HANDS IN WYOMING HELP

ANIMALS

Producing greater yields, they supply most of our diet, but need most land

Americans are among the heartier carnivora. We ate, on the average, 137.6 pounds of meat last year, an amount equalled or bettered by only four other nations.* In addition, Americans annually consume 119 billion pounds of milk, 2,706,000,000 pounds of butter and margarine, more than one billion pounds of cheese, 59 billion eggs, 4 billion pounds of chicken.

Most of our land and crops are devoted to the production of meat and dairy products, and they make up more than half of the U. S. agricultural product. Because of this, agricultural scientists are working to get more meat and dairy products from each acre used for beef and cattle.

An important step in this direction was Du Pont's discovery that urea can be of enormous benefit to cattle. In fact, nitrogen, in the form of urea, is used to supply up to one-third of the cow's protein needs. This additional meat and milk is gained because urea stimulates rapid growth of beneficial bacteria in the cow's rumen. Another advantage is that roughages, such as corn cobs which were once thrown away, can be used efficiently by ruminants which are fed urea. Thus, land once used to raise food for cattle is now used to raise food for man.

Already Du Pont alone has supplied enough of its "Two-Sixty-Two" feed compound to increase the nation's protein yield by 600,000,000 pounds, or the equivalent of all the meat

*New Zealand, Australia, Uruguay, Argentina. Nutritionists believe there is a strong correlation between meat eating and height, noting that those whose diets include meat proteins are, in general, taller than those whose diets are scanty.

VACCINATE CALF FOR BLACKLEG.

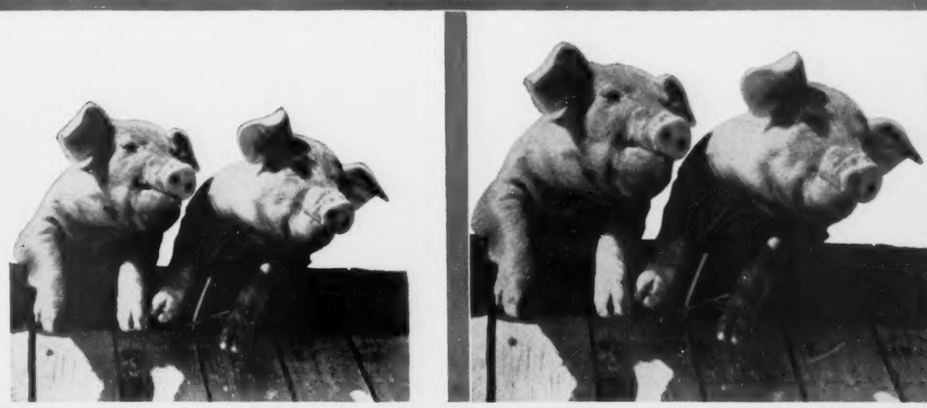
protein consumed by the entire population of the United States in two months.

Also, new strains have produced bigger, more productive animals which require no more food than less productive strains, thereby increasing the output per acre.

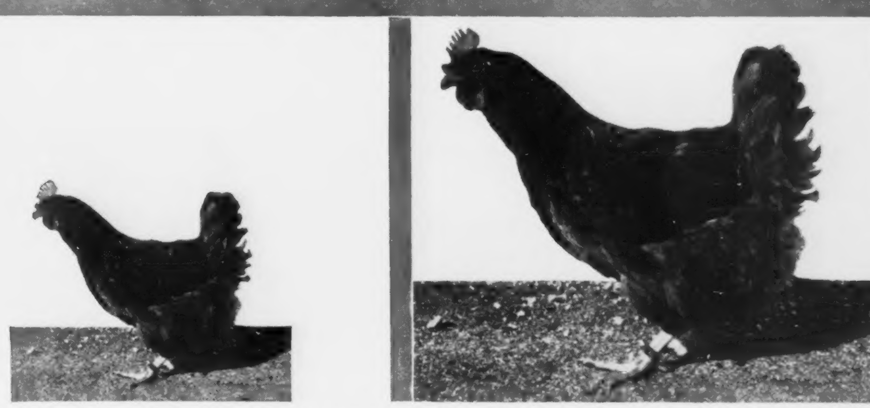
New drugs are making enormous progress in curing and preventing disease. And vermifuges, which attack internal parasites, are allowing the animal's prime product—food—to go to market instead of to the worm.

To see how one American farmer uses science today, turn the page.

BEEF production is up 33 per cent over the 1910 output. Feed supplements containing urea caused part of rise; part is traced to new breeds which give more edible meat per steer; and part to chemical conquest of diseases.



PORK production has registered 30 per cent gain per hog in last 10 years. Chemically-fortified feed brings hogs to market weight in six months instead of the usual eight, on less feed than is ordinarily required; also cuts disease.



EGG production, measured in output per hen, has jumped 71 per cent since 1910. Nation now produces 2½ billion pounds of broilers per year, 5 times as much as in 1940. New feeds, medicinals helped make increases possible.

DAIRY PRODUCTS show 88 per cent rise since 1910 in average amount of milk each cow produces. Cheese and ice cream production also increased. U. S. consumes 1½ billion pounds of butter a year, 57 billion quarts of milk.

BURKHOLDER STANDS ATOP AND SURVEYS MOUND OF FARM CHEMICALS HE USES IN THE COURSE OF AN AVERAGE YEAR.

FARM CHEMICALS

Sparking an agricultural revolution, they add millions to our acreage

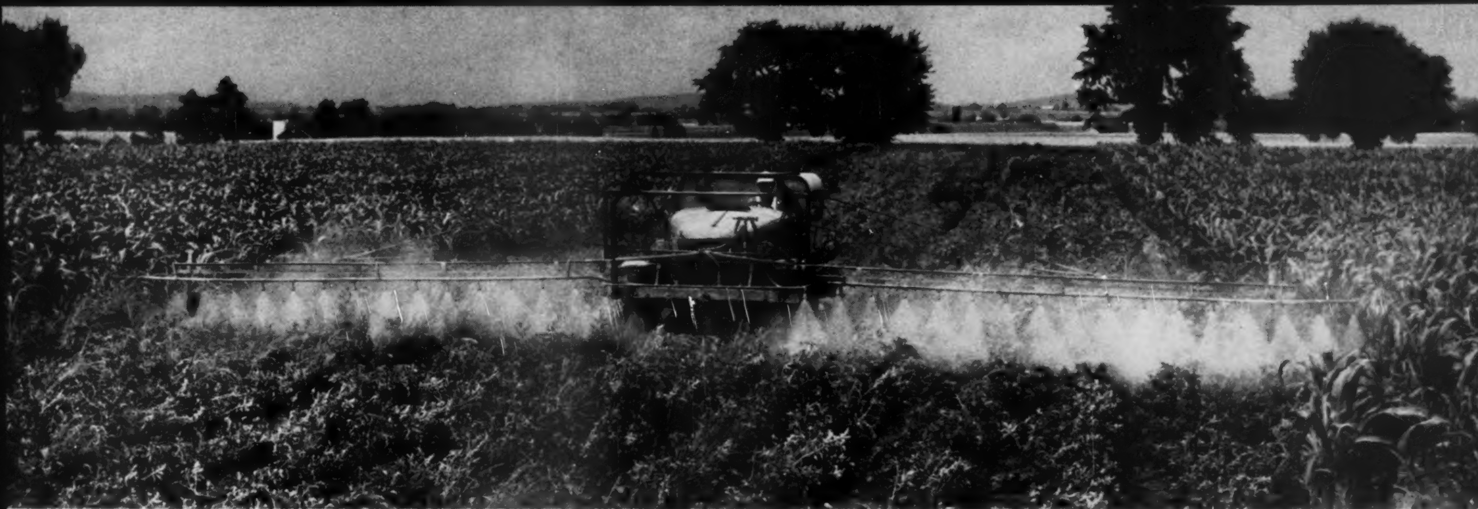
In the last 40 years, farm production has doubled in the face of a 35 per cent decline in farm population. One-third of this increase can be attributed to mechanization and the release of vast acreage which was used to produce feed for the animals that the machines replaced. The remainder can be attributed to scientific advances, many of these chemical in nature.

The gentleman above shares the fruits of scientific progress. He is John D. Burkholder of Lititz, Pa., who was born on a farm and has been farming his present land since 1941. He owns 62 acres, leases 16 more. He has 26 cows, 8 steers, 6 heifers, 1500 chickens. He grows corn, wheat, hay, tobacco, potatoes.

To keep his soil, crops and animals healthy, Burkholder uses a full range of chemicals to their best advantage.* Their amount and variety, as shown in the photograph above – an approximation of his yearly chemical supply – is great.

But the benefits he receives – in terms of yield, quality, productivity and protection of his investment – are enormous.

*This is not true of all farmers. Only one-fourth of all U. S. crop land is now treated with fertilizer; and only one-eighth with pesticides.



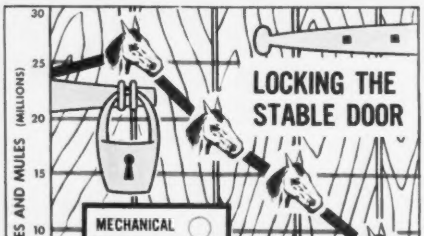
BURKHOLDER'S POTATOES RECEIVE REGULAR FUNGICIDE SPRAYING, WHICH HELPS BOOST HIS POTATO YIELD 100 PER CENT.

CHICKENS on Burkholder's farm are dusted with chemicals to relieve congestion when they are ill. Medicinals and feed supplements increased egg output 71 per cent.

BARN SPRAYING with methoxychlor insecticide controls flies which plague cattle. Flies can weaken and harass cows to point where milk production is cut 20 per cent.

BURKHOLDER'S SOIL IS REGULARLY FERTILIZED TO KEEP IT RICH, FERTILE AND HEALTHY. HE USES MORE THAN 20 TONS A YEAR.

IMPRESSIVE MECHANIZATION OF MODERN FARM IS SHOWN IN BURKHOLDER'S DISPLAY OF AGRICULTURAL IMPLEMENTS.



ANIMAL POWER on farm dropped 78 per cent, mechanical horsepower rose 8000 per cent.

EQUIPMENT POWERS FARMER'S ADVANCE

It speeds the work, extends the farm's borders

In 1910, there were 1000 farm tractors and 25 million horses and mules on U. S. farms. Today, there are well over 4 million farm tractors, and only 5,636,000 horses and mules.* This one fact sums up the advance of mechanization on the farm. To John Burkholder, above, increased mechanization means increased productivity. He can farm more land, plant more crops, spray and harvest them faster. Only a few decades ago, agriculture was primarily a hand operation; today only a few crops — such as tobacco—resist the steady advance of farm machinery.

But there is no question that farm progress and greater yields will come to these crops as it already has to others.

*Many of which do no farm work.

TRACTOR AND PLOW WHICH BURKHOLDER USES DO THE WORK OF THE TEN HORSES, FIVE PLOWS AND FIVE MEN BEHIND HIM.

SEEDING, FERTILIZING are done in one operation with tractor-drawn implement. Machines do this far faster, more efficiently than hand operation.

AT END OF DAY, Burkholder can close barn door without long extra hours of caring for animals. He still works hard, but machines greatly lighten his load.

OFF FOR A VISIT TO FRIENDS, the Burkholders look like any city family. Their large, comfortable house, new car and modern conveniences are the results of hard work and increased farm productivity.

AT BANK, in Lititz, Pa., Burkholder discusses investment of savings with President D. M. Graybill.

LIVING STANDARDS SHOW SHARP RISE

Increasing farm productivity brought with it a corresponding rise in the farmer's living standards. The farmer's rewards no longer trail in the nation's economy. As the photographs here show, in appearance, comforts and conveniences, the Burkholders are no different from any other segment of the population. Electricity is put to use all over their house and farm (in 1920, less than 7 per cent of farm homes were electrified; today, more than 84 per cent are). There are some 5 million farms in the U. S. and there are almost that many passenger automobiles owned by farmers. As his productivity increases, so will the farmer's income, further enriching both farm communities and the nation.

MODERN SCHOOL which young Dean, in father's arms, attends as a first-grader reflects high living standards of farm communities, new opportunities for younger generations raised on the farm.

AFTER CHURCH, Burkholders are greeted by their pastor, Rev. Francis Bell. Church has 1000 members.

SHOPPING for a sport jacket at store of J. B. Hess, in Lititz, Burkholder enjoys fruits of his work, adds wealth to the community.

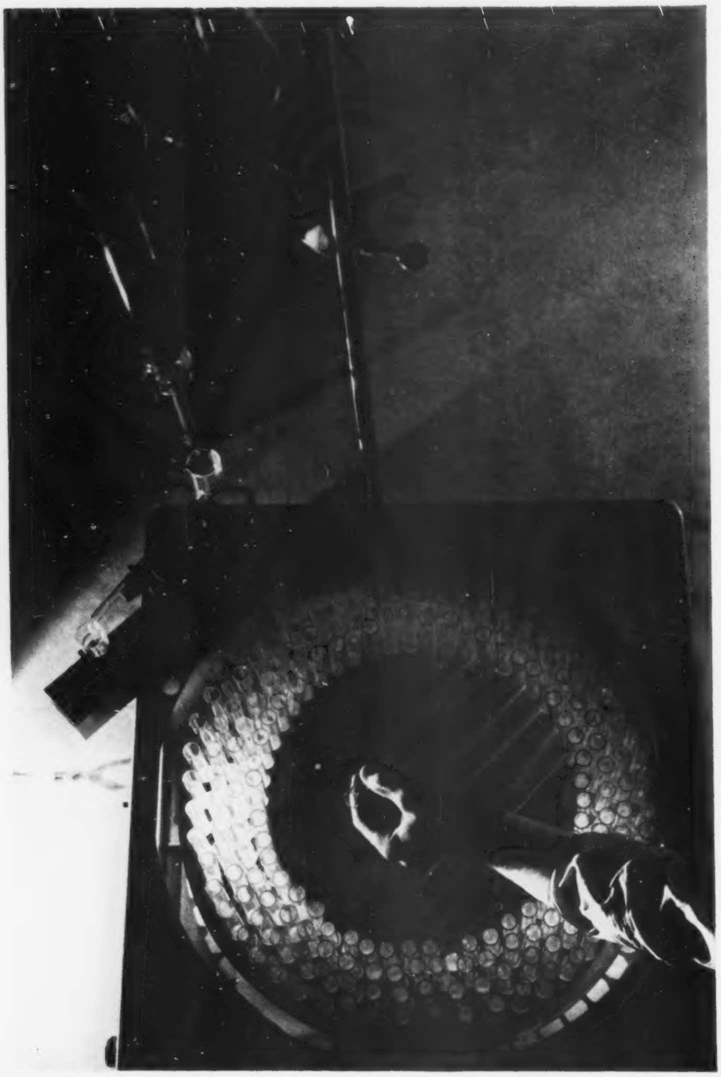
PLAYING with son, Dean, takes up part of Burkholder's new-found leisure. Farm children today work less, get more schooling and fun than youngsters of 50 years ago.

MRS. BURKHOLDER DISPLAYS SOME CONVENIENCES* WHICH HAVE REMOVED MOST OF THE DRUDGERY FROM HER HOUSEWORK.

*Shown are fan, vacuum cleaner and attachments, phonograph, electric blanket, electric floor polisher, television set, heater, thermostatic control for automatic stoker in coal furnace, electric light, electric coffee pot, intercom for baby's room, deep fryer, corn popper, telephone, radio, infrared lamp, sewing machine, electric clock, toaster, iron, bottle warmer, mixer, blender, refrigerator, automatic defroster for refrigerator. Not shown: dish washer, electric range, pressure pump, clothes washer, clothes dryer, deep freeze unit, hot water heater. Missing: waffle iron in repair shop.

THE NEED: MORE FOOD

The search for vital "new land" takes unusual and strange forms



REVOLVING TEST TUBES, in a fraction collector at Du Pont's Stine Laboratory, hold key in chemistry's search to find newer, better ways to help U. S. farmer.

Every person concerned with U. S. agriculture now runs into a stone wall—a wall so high that to a less industrious and ingenious people it would prove insurmountable. Unlike the situation of 50 years ago, there is no new and fertile land to break to the plow; little new crop land has been added to our farm land since 1920. Yet there is a booming rise in population. By 1975 – a single generation away – another 60,000,000 hearty appetites will demand satisfaction. Unless something is done quickly, the U. S. will have to undergo what amounts to a revolution in its eating habits.

It has been estimated that this additional population will require the equivalent of 200,000,000 new acres of farm land, almost one-half of the acreage now devoted to crops. To meet these needs, our scientists and agricultural experts are probing some interesting and unusual paths to find the necessary "land."

On this page are shown some phases of Du Pont biochemical research. And on the opposite page are shown other productive areas of research: new breeds which will put more flesh on our animals and bring them to maturity faster; reclamation projects to bring back to life the land which is exhausted and useless; improved packaging and food preservation to cut the awful wastage of food before it gets to the consumer; immunization from plant and animal diseases to cut farm losses and provide more for the U. S. dinner plate.

The challenge is great, but the research forces now being marshalled to meet and overcome it are greater.*

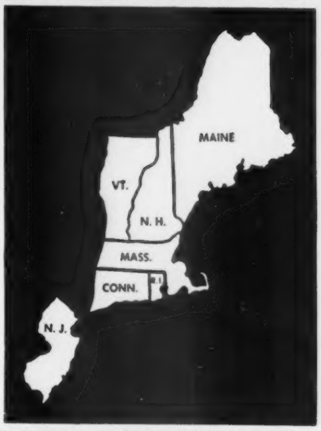
SAFETY GLASS HOOD at Stine Laboratory protects technician Molly Bradshaw's special bacterial cultures from danger of airborne contamination.

REMOVING BACTERIA from test tubes, left, to nutrient-filled Petri dish, in hand, is first step in basic research into nature and action of bacteria.

*A comforting thought: Between 80 and 90 per cent of all 1953 farm chemical business was built around chemicals which were not available in 1945. There is no reason to suppose that a similar situation will not prevail in another decade.

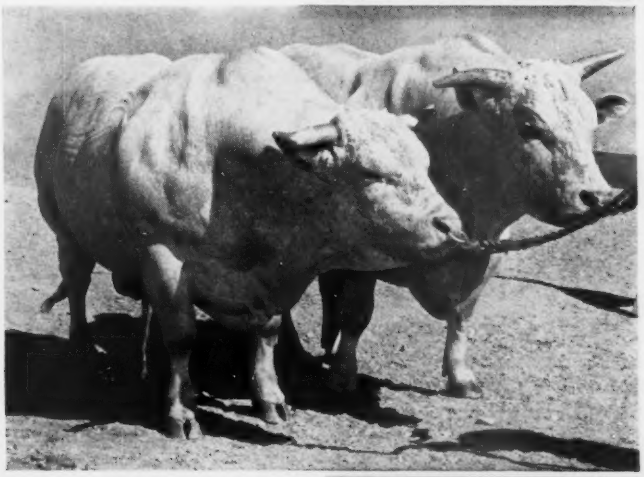
RECLAMATION

of poor land through large-scale irrigation projects (above), contour and strip plowing, and erosion control can add 45 million more acres for U. S. farmers. This is more than four per cent of all of the nation's present farmland or as much as *total area* of states at right. Problem is great because it is a very slow, costly process.



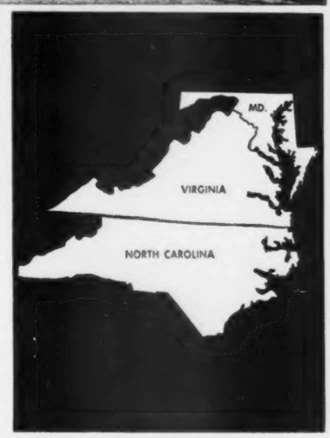
IMMUNIZATION

against plant and animal diseases is goal of researchers like one above, who uses radioactive materials to trace progress of test chemical through plants. Diseases, coupled with insects, destroy at least 25 per cent of nation's farm output. If this loss can be eliminated, the effect would be the same as addition of all land at right.



NEW BREEDS

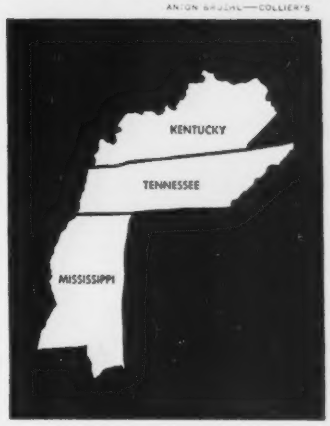
like Charbray bulls gain weight fast, are more disease resistant, give higher percentage of edible meat. In future, better breeds can mean 15 per cent more meat production per acre of pasture. The gain would be equal to 61 million acres (area at right). Improvements in cattle feed can give U. S. equivalent of 154 million acres.



ANTON BRUEHL—COLLIER'S

PACKAGING

and preserving are vital areas for study since spoilage destroys 20 per cent of all food between farm and kitchen. One field is atomic radiation of food. Atomically irradiated food, above, sealed in plastic and placed on an open shelf, stayed fresh one year without refrigeration. Spoilage elimination would gain equivalent of 81 million acres of cropland.



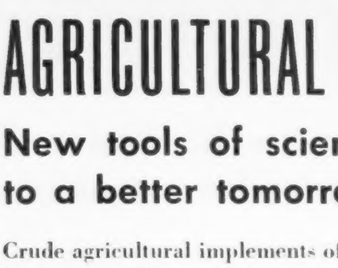
MODERN TOOLS OF AGRICULTURE ARE MICROCHEMICAL IMPLEMENTS USED BY SCIENTISTS SEEKING BETTER FARM CHEMICALS.

AGRICULTURAL IMPLEMENTS

New tools of science are the key to a better tomorrow for everyone

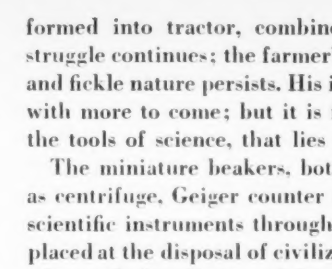
Crude agricultural implements of ancient civilization (see below) were early expressions of man's ceaseless drive better to feed his family by wresting more from field and pasture. Through the centuries, these ancient tools have been transformed into tractor, combine and cotton picker. Yet, the struggle continues; the farmer's battle against disease, weather and fickle nature persists. His implements are vastly enhanced, with more to come; but it is in a new kind of implement, in the tools of science, that lies man's greatest hope.

The miniature beakers, bottle and crucibles above, as well as centrifuge, Geiger counter and spectrophotometer, are the scientific instruments through which new knowledge is being placed at the disposal of civilization. Provided with this knowledge and the climate of freedom and reward which spawn great achievement, scientists possess the ability necessary to eventual solution of man's oldest and most basic problem.

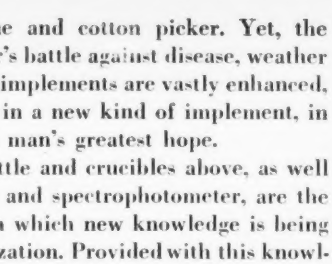


PLOW, dating back to 6000 B.C., changed hardly at all until 1800 A.D.

SICKLE was man's best harvest tool for centuries, dates from 3000 B.C.



RAKE of primitive days was crudely made, broke easily, wore out quickly.



CULTIVATOR used in ancient Egypt was inefficient and back-breaking.